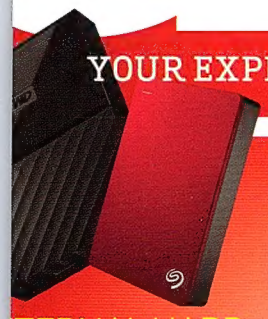
# HE FUTURE OF GAMING

DISCOVER WHAT'S NEXT FOR GAMING ON PC, CONSOLE, VR, BLOCKCHAIN... AND BEYOND!

# apc

Sept 2018
Issue 458

YOUR EXPERT GUIDE TO TODAY'S TECH



## BUILD A $500 QUAD-CORE INTEL PC

DIY PROJECT OF THE MONTH: WE REVEAL ALL THE PARTS YOU NEED TO CONSTRUCT A PUNCHY CORE i3 SYSTEM FOR A PINT-SIZED PRICE (IT'S EVEN GOT AN SSD!)

## TERNAL HARD RIVES TESTED

'E IDENTIFY THE BEST VE FOR YOUR NEEDS IN R HUGE BUYER'S GUIDE

## ACKING UP TO THE CLOUD

'UGED: EVERYTHING YOU IEED TO KNOW ABOUT KING YOUR FILES ONLINE

# BACK UP NOW TO AVOID CATASTROPHE

DON'T WAIT UNTIL IT'S TOO LATE! GET YOUR BACKUP SITUATION SORTED WITH OUR COMPLETE GUIDE FOR WINDOWS & MAC: WE'VE MADE IT EASY!

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## LEARN ESSENTIAL TECH SKILLS

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- CREATE STUNNING HOME VIDEOS ON iPHONE OR iPAD
- MASTER THE ART OF FILE NAVIGATION ON LINUX

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- WD WIRELESS SSD: PERFECT FOR ON-THE-GO PRO-PHOTO BACKUPS
- MSI GS65 STEALTH: IS THIS THE PINNACLE OF GAMING ULTRABOOKS?

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# Block 99.9% of phishing emails.

Phishing emails have plagued corporate inboxes for years. They dupe unsuspecting employees into revealing their account information which can lead to data breaches. That's why Gmail on Google Cloud uses machine learning to block 99.9% of malicious emails from ever reaching your inbox. See how we do it at **g.co/cloudsecureAU**

## Go make it.
## We'll protect it.

Google Cloud

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# BACK UP NOW TO AVOID CATASTROPHE

DON'T WAIT UNTIL IT'S TOO LATE! GET YOUR BACKUP SITUATION SORTED WITH OUR COMPLETE GUIDE FOR WINDOWS & MAC: WE'VE MADE IT EASY!

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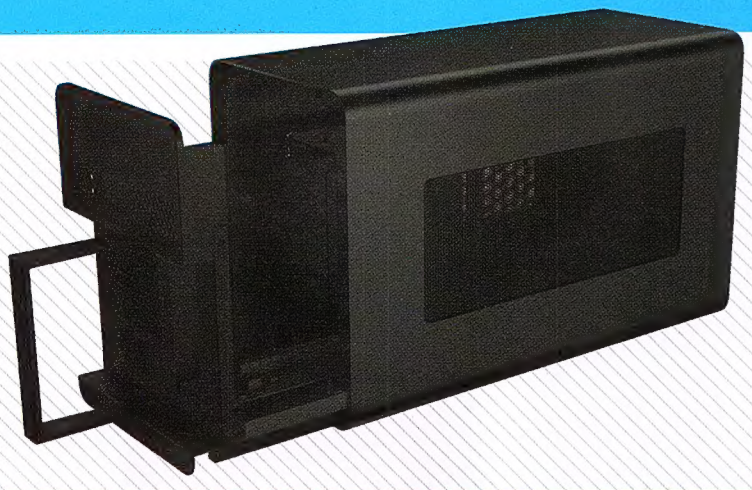

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# exclusive software

» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

ISSUE 458, SEPTEMBER 2018

Please note that these exclusive *APC* & *TechLife* magazine downloads will only be available for a limited time, from **13/08/2018 to 30/09/2018**

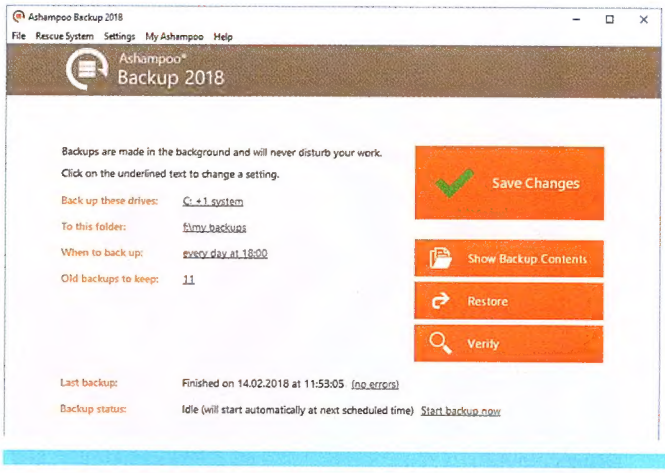
## NEVER LOSE YOUR DATA AGAIN

**BACK UP WITH PEACE OF MIND WITH ASHAMPOO BACKUP 2018**

**FULL VERSION WORTH $20**

If you've ever sat in front of a black screen because your Windows refused to start, you know the value of backups. But it's so easy to keep your data safe! Backup entire disk partitions in just a few clicks and restore your files even in the event of a total system failure — that's what Ashampoo Backup 2018 is all about. This application was specifically designed to do the heavy lifting for you, that means safety without the need for constant user interaction or system slowdown. It's simple, it's fast and it's safe!

**DOWNLOAD LINK:** **www.ashampoo.com/lpa/apc**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Click on the underlined text to change a setting.
Back up these drives: C: + 1 system
To this folder: f:\my backups
When to back up: every day at 18:00
Old backups to keep: 11
Save Changes
Show Backup Contents
Restore
Verify
Last backup: Finished on 14.02.2018 at 11:53:05 (no errors)
Backup status: Idle (will start automatically at next scheduled time) Start backup now

## PROTECT YOURSELF FROM BIG BROTHER

**FOIL WINDOWS SPYING WITH ABELSSOFT WIN10PRIVACYFIX**

**FULL VERSION WORTH $20.**

Foil Microsoft's attempts to gather your personal information: Win10PrivacyFix blocks Microsoft's data transfer server and disables the relevant services. Win10PrivacyFix also optimises Explorer and background services, helping to stop, for example, the persistent activation of the microphone or the regular transmission of keystrokes. Take back security and control of your system: Win10PrivacyFix helps you manage the balancing act between comfort and privacy.

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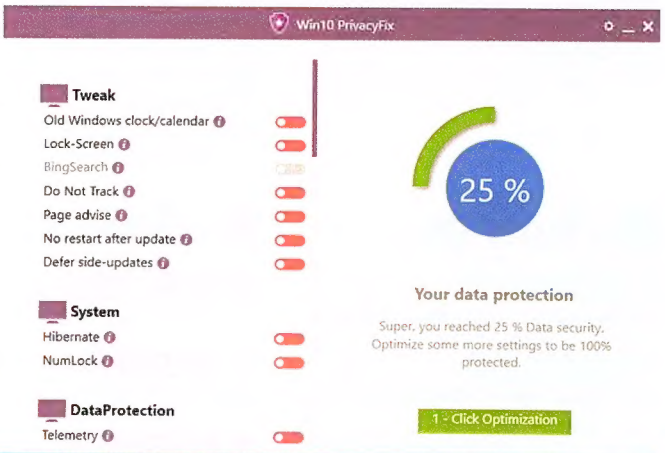


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# The downsides of the digital transformation

## APC's editor is reminded that there are still many areas where old beats new, and local beats global.

The arrival of new technologies like big data and machine learning have allowed us to take our first steps into the world's second big digital transformation – one where solutions to both consumer and business problems can be delivered in more precise and individually tailored ways.

They undoubtedly hold a lot of promise; however, I can't help but feel a little disheartened when I'm reminded on a near daily basis that today's tech still has a long way to go. When it comes to consumer-facing applications, those 'smart', data-driven solutions are often in the hands of tech giants – and, as we've seen, they're not always putting the users first.

Let's take smart speakers and the weather. My Google Home sucks when it comes to telling me if it's going to rain or not today. That's because, no matter where you live, Google uses just one weather source for all of its forecasts – the IBM-owned and US-based weather.com. While I can't vouch for its accuracy on its American home turf, if you compare weather.com's Australian forecasts with any reputable local source, you'll find the former's are way out of whack – often by several degrees, and particularly when it comes to predicting precipitation. A web search shows similar complaints about weather.com from Google users in other countries, too.

This weather problem is, for me, a bit of a microcosm of what we've seen (and continue seeing) occur to media in this age of rapidly advancing digitisation and automation. The way information is being disseminated is increasingly being taken out of human hands and, in many areas, that's resulted in the destruction of tailored, localised solutions in favour of a one-size-fits-all approach. The maddening part is that getting accurate weather is a software engineering problem – the kind of thing that Google and Facebook as supposed to *love* because, once the developers have written the code, it doesn't require significant resources to maintain it. (They don't need to pay anyone.)

If the tech giants care about providing users with accurate info – like they repeatedly claim to – you'd think that something as uncontroversial as getting the local weather right would be an easy win.

So how about it, Google? Can you spare some dev time to fix this 'easy' problem? I can wait. In the meantime, I'll just keep packing my brolly... ■

**DAN GARDINER**
**EDITOR-IN-CHIEF**
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## Australian Human Rights Commission investigating pros and cons of technology

BRINGING HUMAN RIGHTS TO EMERGING TECH.

Australia's Human Rights Commissioner Edward Santow has announced a two-year project to "consider how law, policy, incentives and other measures can be used to promote human rights" before it chalks out a plan for future reform. Suggesting that technology is changing what it means to be human, he wants Australia to focus on "responsible innovation" before economic inequalities present themselves in the wake of advancing technology. SS

## Twitter purges 70 million accounts

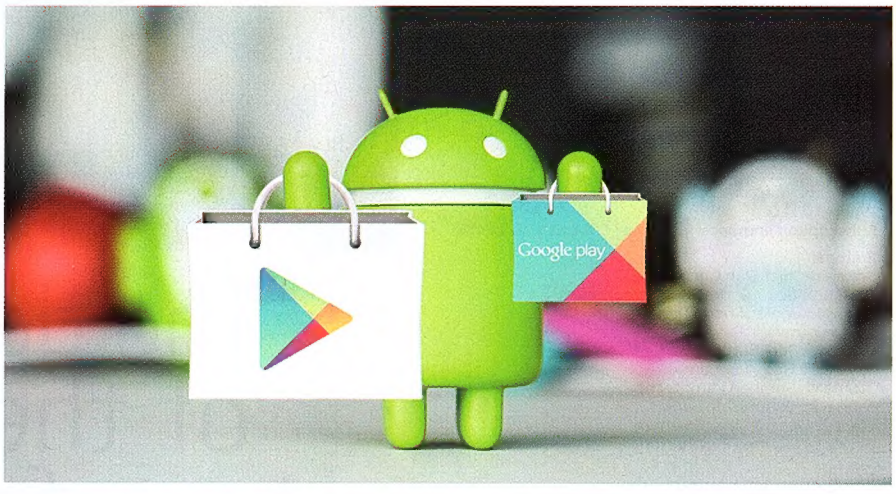
THE WAR ON BS INTENSIFIES.

In the war on trolls and fake accounts, Twitter is deleting one million accounts a day, and has wiped 70 million since May. It has issued warnings that users will probably see a reduction in their number of followers. The vigorous attempts to clean house shows a shift of focus at Twitter, which previously championed free speech above all else. Del Harvey, VP for trust and safety, said, "Free expression doesn't really mean much if people don't feel safe." How many accounts are fake is difficult to estimate; Twitter reckons it's at 5%, while other studies put it at 15% or more. CL

## Research claims some Android apps are secretly recording your screen

BUT YOUR PHONE ISN'T EAVESDROPPING.

People have believed that their phones have secretly been listening to them to gather data for targeted advertising for a long time now, building a myth that a bunch of computer science academics at Northeastern University in Boston decided to look into. While they found no evidence to suggest that phones are eavesdropping, they did discover a bunch of Android apps that record the device's screen and send that data to third parties, some of whom make no mention of it in their privacy policy. SS




# Google faces record $6.8 billion fine in EU, ordered to remove Chrome from Android

## Has 90 days to implement changes.

**If Android phone manufacturers want access to the Play Store, Google requires them to preinstall Chrome and Search apps on the device, and European antitrust regulators are none too happy with that. The European Commission has accused Google of forcing phone makers to preinstall the browser and search tool, of paying larger manufacturers and mobile carriers to ensure Google Search is the exclusive search app and preventing phone makers from installing 'forked' Android versions not approved by Google.**

The internet giant has been slapped with a record €4.3 billion fine for abusing the Android operating system's dominance in the smartphone market, the largest fine imposed on a company in EU history. The ruling against Google stipulates that the company will need to unbundle its Chrome and Search apps from Android, which may significantly change the free business model the tech giant has been pursuing with the mobile OS.

Google has been given 90 days to cease all illegal practices or face additional fines of up to 5% of Google parent company Alphabet's global turnover, but the company has stated it has plans to appeal the decision. **Sharmishta Sarkar**

## Connecting to the NBN should be easier in future

ACMA LAYS DOWN NEW RULES FOR TELCOS.

New rules recently outlined by the Australian Communications and Media Authority (ACMA) will mean that every telco has to follow a checklist when connecting new customers to the NBN. The change has been implemented after the government body conducted research into the state of the NBN and found that "almost one in six households moving to an NBN service was left without a working connection for more than a week" and "for almost one in 10 households, the interruption was for more than two weeks".

To fix the migration hiccoughs, ACMA now requires all telcos to conduct a line test to ensure a customer's NBN connection is working after installation and also verify that the existing copper wire use to connect the customer to the NBN is capable of delivering the maximum speeds specified in the chosen plan. They must also offer an interim service or make other acceptable provisions for customers where the new NBN service isn't working and cannot be fixed within three days. Besides that, telcos are now also obligated to give consumers the information they need to choose an NBN plan that works for them and resolve any consumer complaints swiftly, even if it means involving other companies in the NBN supply chain if necessary. **Sharmishta Sarkar**

# Microsoft hopes to tackle iPad with cheaper Surface Go tablet

## Also takes another stab at students.

**Microsoft's Surface Pro has been a success, to the surprise of some, as Microsoft's record with PC hardware is patchy. It has a funky, moderately innovative design, and an air of class. The smaller Surface models fared less well, initially being underpowered, and lacking full x86 compatibility. Microsoft stopped selling the previous small model, the Surface 3, in 2016. Now it's back with the Surface Go.**

The Surface Go follows the established design pattern with a detachable keyboard, a back stand, 3:2 Gorilla glass touchscreen with stylus support, front and back cameras, and a magnesium case. Only it's smaller and lighter than any previous model at a svelte 24.5x 17.5cm, and just 8.30mm thick. It weighs in at 522g (not including the keyboard). The 10-inch screen has a resolution of 1,800 x 1,200, which gives a pixel density of 216 per inch.

Inside, it gets a proper Intel engine, as opposed to a weedy Atom one. The Pentium Gold 4415Y is a dual-core Kaby Lake part, and runs at a base clock of 1.6GHz. There's either 4GB or 8GB of memory, and 64GB or 128GB of storage. It runs Windows 10 Home in streamlined mode, although you can change up to full-fat Windows. Battery life is quoted at a useful nine hours. The base model sells for $599, about half the price of a Surface Pro. The range tops out at $839, with Type Cover costing $199.95, with more models to follow.

An obvious target for the Surface Go is education, a competitive and potentially lucrative sector; every student wants a tablet or similar. The Surface Go has a hill to climb, as Apple's new entry-level iPad is from $469, and Chromebooks are cheaper still.

## Facebook now actively removing posts with 'misinformation' that could lead to violence

NEW POLICY ALREADY TRIALLED IN SRI LANKA.

In a statement to CNBC in July, a Facebook spokesperson has revealed that, "There are certain forms of misinformation that have contributed to physical harm, and we are making a policy change which will enable us to take that type of content down." Technically, the policy will be implemented "during the coming months", although it has already been used in Sri Lanka, where the recent spread of false information targeting the country's Muslim minority has lead to multiple instances of mob violence.

The policy will target both text and image content that is deemed to be deliberately inflammatory, but who makes the call on what's acceptable speech and what's not? Along with the social media's existing image-recognition technologies, Facebook says it will work with local and international organizations to both identify and verify the intent and veracity of the posts in question. While these external parties are yet to be identified, the matter of the impartiality of these organizations is obviously going to play a significant part in the success of the policy overall, just as Facebook itself promises to hold the same standard of neutrality. **Harry Domanski**

## YouTube will begin promoting and paying for legitimate news

SOME NEW APP FEATURES ALREADY ON SHOW.

YouTube has announced it will spend US$25 million on employing experts to help develop news-specific features, funding sustainable video operations in 20 global markets, and expanding YouTube's existing support team that is dedicated to training and assisting news organisations around the world. Some of the features include contextual summaries on historical and scientific topics, breaking news updates, verified news channel promotion, and other features designed to prevent misinformation. **HD**

## Apple fixes keyboard problem on 2018 MacBook Pro

CRUMBS AND DUST SHOULDN'T BE AN ISSUE NOW.

Although not specifically blamed, it is thought that crumbs, dust and other tiny particles are responsible for causing stuck or repeating keys on 2015–2017 MacBook Pro key-beds. Apple has addressed the issue (albeit, without officially acknowledging it as such) with the 2018 model by placing a thin layer of silicon between the key and the butterfly mechanism — however the official line is that this is to provide quieter typing. **HD**

## New Intel Core i9 MacBook Pro throttling due to heat

APPLE RELEASES SOFTWARE PATCH TO ADDRESS THE ISSUE.

Shortly after release, Apple's brand new top-spec 2018 MacBook Pro was found to be struggling with its Intel Core i9 CPU, seemingly throttling performance due to heat. Apple has since released a patch that replaces a "missing digital key" that the company claims should resolve the thermal management issue, although at time of writing, to what degree throttling still occurs is yet to be determined. **HD**

# numbercrunch

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS

## 45%

**THE NUMBER OF IT SECURITY PROFESSIONALS THAT ADMIT TO RE-USING PASSWORDS**

During the Infosecurity Conference 2018 in London, a survey of over 300 security professionals found that almost half of them re-use the same password across multiple sites and services. That figure would be a little scary (albeit unsurprising) if it were just taken from a portion of the general public — but to have the *experts* in the field not practising what they preach is even more alarming. The security risks associated with password re-use are obvious, but this can easily be avoided with password management tools (such as LastPass, KeePass or 1 Password) or a personalised system for creating unique passwords.

## 23.6TB

**THE AMOUNT OF DATA DOWNLOADED BY THE NBN'S HEAVIEST USER EACH MONTH**

Recently released figures from NBN Co shed light on some of the specific details surrounding the network's usage and, indeed, some of its extreme outliers. The revealing stats show that the network's top user is downloading up to 23.6TB of data each month, while the median user is only pulling down 108GB. They also divulge that the top 14% of all NBN users account for half of the network's overall downloads, while a smaller 6% are responsible for half of all uploads.

## 125 MILLION

**NUMBER OF FORTNITE PLAYERS (AND RISING)**

It's not even a year old yet but *Fortnite* has amassed quite the following since launch. According to the latest figures presented in a blog post from developer Epic Games, the battle royale title has 125 million registered players as of mid-June. To celebrate, the next competitive season of the game (2018–19) will feature a ludicrous US$100 million prize pool, spread across a series of events over the year.

## 52 MILLION TONNES

**AMOUNT OF ANNUAL E-WASTE EXPECTED TO BE PRODUCED GLOBALLY BY 2021**

In the last nine years, the amount of e-waste produced globally has doubled, according to the United Nations University in Tokyo, Japan. Currently, the world produces around 45 million metric tonnes of electronic waste each year, and by 2021, this is expected to surpass 52.2 million tonnes. What's worse is that only 20% of all e-waste is recorded as being collected by the appropriate programs and recyclers, and only 41 nations officially record information on e-waste at all.

## DOUBLE

**FOCUSED CYBER ATTACKS ON AUSTRALIAN ORGANISATIONS HAVE INCREASED TWOFOLD SINCE LAST YEAR**

Analysis by consulting firm Accenture has found that the number of focused cyber attacks on Australian organisations has almost doubled since last year, averaging out at 232 attacks per business. The good news is that the increasingly hostile digital environment has prompted companies to upgrade their defences. While 2017 saw organisations successfully prevent 70% of the attacks against them, in 2018, that percentage actually increased to 87%.

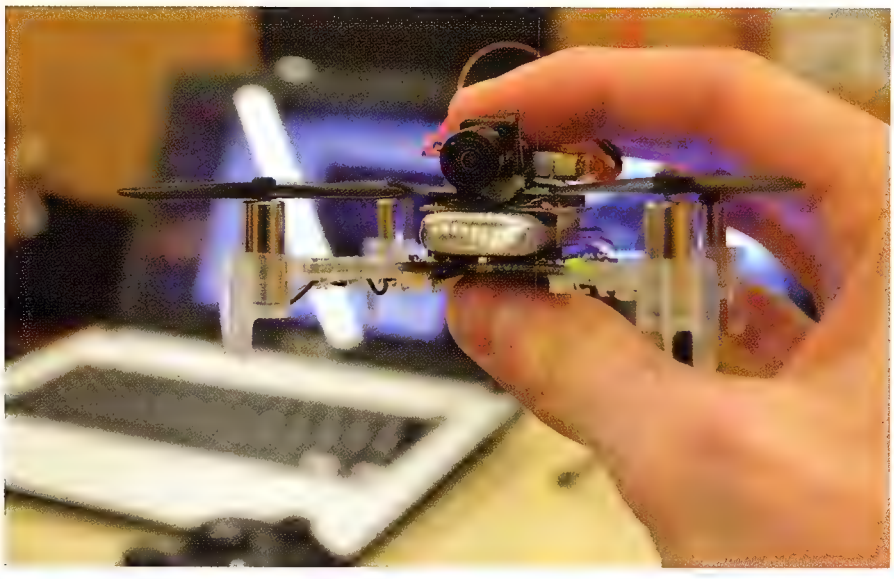
# techbrief

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK

# Switching to auto-pilot

## AI is increasingly being deployed in the real world.

**Far from terminating, exterminating or deleting all human life, artificial intelligence is (for now, at least) still an ally of our squishy ape-based species. The last time we looked at this subject, NASA was using Google's AI to detect new planets and social robots were being created to give the elderly somebody to talk to. The application of artificial intelligence is, indeed, vast and wondrous – and we're going to throw a few more examples at your eager eyes this issue, including in the law department (not quite to the status of silly-wig-wearing, but we live in hope), flight and the ever-developing medical industry.**



### AI can now fly drones

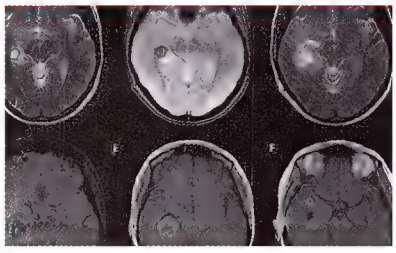
Crazyflie 2.0 is a super-small nanodrone.

Researchers from university ETH Zurich and the University of Bologna have constructed an autonomous flying drone that's the size of your hand. Powered by the neural network DroNet, it can control its own flight path and avoid collisions by processing images from its onboard camera at 20 frames per second. This is a major step forward due to the size of the drone, as all processing of images occurs on the drone itself, meaning all tech has been squeezed onto this tiny body. Pretty nifty!

### Facebook's AI removes iffy content

Automatic sterilisation.

With over 2.1 billion users, Facebook would have a fair amount of content that requires moderation. According to FB's Vice President of Product Management, the company was developing software that could analyse reported "bad content" and remove it. The AI is currently capable of identifying potential policy violations (such as hate speech and nudity) and flagging them, but is not yet responsible for the actual removal of the content.



### Chinese AI beats doctors in recognising tumours

BioMind to the rescue!

A Chinese AI system has outperformed a team of 15 top doctors in diagnosing brain tumours. The AI, BioMind, correctly diagnosed tumours 87% of the time, compared to the score of 66% achieved by the Chinese doctors, and managed to achieve that score in half the time.

### AI can deduce political geography by analysing cars on Street View

You are what you drive.

A research team largely from Stanford University have analysed whether there's a link between certain areas' voting habits in the US and the cars they drive, judging by what's seen on the roads on Google Street View. With the help of a neural network (which processed 50 million images in only two weeks), the team discovered that urban areas with a large number of pickup trucks had an 82% chance of voting Republican, while other areas with more sedans had an 88% of voting Democrat. The lead author of the study stresses, though, that this is nowhere near as accurate as actual census data. Still...

### AI investigators used on Rolls Royce fraud case

Robot lawyers take the stand.

A machine learning algorithm has been used by the Serious Fraud Office in the UK in a case against Rolls Royce. The algorithm was tasked with finding legal privilege documents amongst the 30 million documents that the defendant turned over. It was good enough at this task to convince the head of the SFO, David Green, that the software could conceivably be used to also weed out evidence in future cases. ■

# gadgets

» GEAR WE WANT

## TICWATCH PRO

A smartwatch that ticks all the right boxes.

**US$249.99 | WWW.MOBVOI.COM**

While most APC readers will have drooled over a smartwatch at some point, for many, they're a decadence that doesn't quite offer enough obvious usefulness to justify splurging on another device you've got to charge every (other) day. If that's you, serial Kickstarter brand Mobvoi wants you to take a look a their latest TicWatch Pro, an 'affordable' Google Wear OS smartwatch with IP68 water resistance, heart rate and GPS tracking, NFC payment and a dual AMOLED screen that's able to give the device a 5-30 day battery life. Mobvoi's software team started out in natural language processing, so its entire range of devices offer first-rate Google Assistant integration too. **JB**

## SONY WI-1000X

In-ear headphones that cut through the noise.

**$449.95 | WWW.SONY.COM.AU**

Sony's h.ear range of neckband earbuds are still our favourite when it comes to uncompromising high-res audio, but the company is also leading in the noise cancelling space with the WH-1000MX2s – these latest neckband earbuds add noise-cancelling and have two impressive pedigrees to draw from. Featuring adaptive noise cancelling that adjusts the profile based on the surrounding environment, high quality 9mm dynamic drivers, high resolution LDAC Bluetooth audio and a 10 hour battery life, the WI1000Xs do serve up a lot to try and match their higher price. What's hard to glean from the specs is just how well the drivers work in the the neutral audio space created by Sony's active noise cancellation tech. **JB**

## 8BITDO WIRELESS USB ADAPTER

Control all the controllers.

**US$20 | WWW.8BITDO.COM**

Controller manufacturers do their best to make it difficult for you to use their gamepads on anything other than the console or device they were designed for, which is a downer if you like to play multiplayer games across your console, PC, smartphone and/or other gaming devices. While there're a few workarounds available, gaming accessories maker 8BitDo seems to have come up with a fix-all solution. The Wireless USB Adapter plugs into a PC, Mac, Nintendo Switch, Android TV or Raspberry Pi and connects it to Xbox One, PlayStation DualShock 3/4, Nintendo Switch, Wii or third-party controllers – meaning you can finally use the controller you want on the platform you want. **JB**

## HAYNES RETRO ARCADE KIT

Get your 20c coins ready

**US$28.99 | PREZZYBOX.COM**

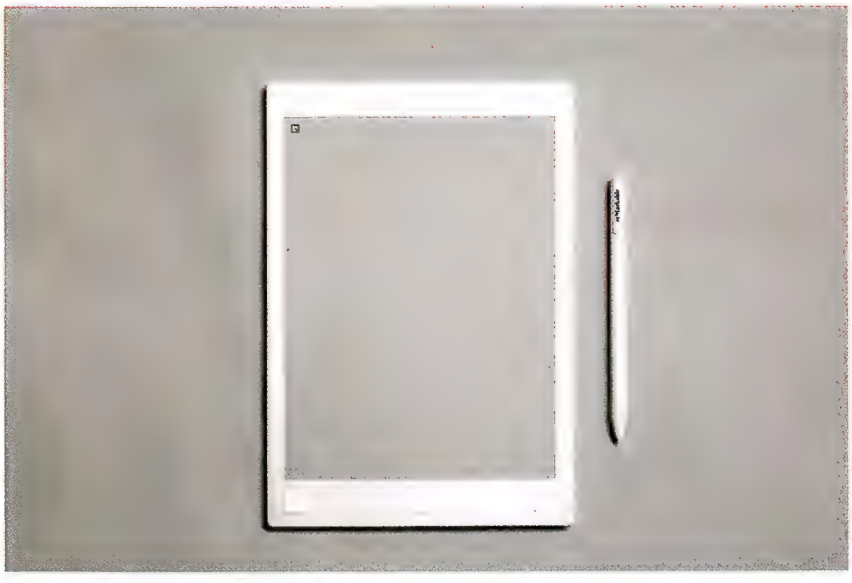
The Retro Arcade DIY kit looks perfect for classic gaming fans or anyone wanting to dabble with simple electronics. Once completed, you have a fully-functioning (right down to coin activation) Pong-style game and an excellent display piece thanks to a great-looking colour scheme. However, the instructions can be slightly challenging to understand as steps are combined into large paragraphs of text and some soldering is also required during assembly. Great for reliving childhoods.

## REMARKABLE

The paper tablet.

**US$599 | REMARKABLE.COM**

The reMarkable promises the most paper-like drawing experience of any tablet. Its E-Ink display is matte and textured, so it's designed to feel like paper and be gentle on the eyes. Unlike a regular tablet, you can't browse the internet or check your email... which could be just the thing to help you switch off from the outside world. Its associated Marker pen requires no battery, but still has pressure sensitivity and tilt sensing.



## UHANDY LITE

Plenty of scope.

**US$34.95 | LOVEUHANDY.COM**

The µHandy Lite promises to bring the invisible microscopic world around you into view via your smartphone. Whether you're interested in investigating the tiny diatoms growing in a puddle or having a closer look at the petals of your favourite flower, this portable mini microscope is surprisingly powerful. Just clip it onto the lens of your smartphone, download the app and start exploring! We were particularly pleased that we could ditch cumbersome glass slides and coverslips for µHandy's unique stickers. Gently tap one of the provided stickers onto your sample and it's ready to take a look at. If plant and animal tissue samples aren't your thing, the Sample Cap and Bubble Sampling Sticker lets you observe microscopic aquatic creatures. Collect your stickers in an album so you can revisit them later on. ■

# Head to head: Keyboard switch types

## The APC team pits mechanical vs membrane vs optical keyboard switches in a three-way battle.

**There's a lot going on in keyboards, and it's time to put the key technologies in a jar and shake them. Note, though, that by membrane, we're referring to dome-switched keyboards (rather than the flat variety you might have on your microwave), and we're looking at the Wooting One as our prime example of optical. Mechanical, at this point in its evolution, is something we can't pin down as accurately, so we're taking a broader view of that...**

Mechanical: Originally a Cherry staple, mechanical switches now have all sorts of variants.

### Round 1

**RESPONSIVENESS**

We have convinced ourselves that the faster a keyboard reacts, the better it is. And in many ways, we're right: Earlier key switch actuation reduces tendon strain by allowing a lighter touch and preventing the shock that bottoming out sends back down to the wrists; it also gives you that extra femtosecond advantage in Twitch games, although if you're not a *Starcraft* pro, it isn't as valuable as you might think.

Whatever the importance, membrane loses out here. Certain designs may have a dome and actuator that squish the appropriate contact on the circuit board more quickly, but you'll almost always find yourself going full-travel with your switches. Mechanical is a mixed bag, given the difference in actuation points and spring stiffness between various key switches, although the vast range of options means something suitable – and suitably sensitive – is always around the corner. But optical switches, at least if we're looking at the mechanical-optical combo of the Wooting One, can be as responsive as you like, offering the chance to customize your actuation point to the precise level your fingers love. All this, plus optical switches typically have the shortest debounce time.

**WINNER:**
**Optical**

### Round 2

**TACTILITY**

There are differing schools of thought on the subject of keyboard feel, and it's difficult to pick a winner without offending a small contingent of the keyboard community. It's very easy, for example, to belittle membrane fans, those poor deluded masochists who love to mash down on squelchy rubber domes, rather than treating themselves to the proper experience of mechanical switches. But we'd be wrong and obviously biased to do so, so we won't. And there are mix-up boards, so-called "membranical" chimeras, which go some way to improving that feel. Equally, there are also mechanical keyboards on the market that feel, at least to these fingers, like utter garbage – take away the bite, and it's very possible to make a mess of your key switches.

Optical, despite originating in the 1960s, is still evolving, so there's not a lot to choose from at this stage, certainly not the variety of mechanical-only switches. In theory, optical keyboards should give rise to mechanical key switch designs that don't have to confirm to the usual norms, and therefore end up feeling quite different, although continued development of the format will really depend on its popularity taking off.

**WINNER:**
**Mechanical**

### Round 3

**VALUE**

We don't suggest that you select a keyboard on the basis of its low, low price – although you're welcome to, if you're the kind of person who also buys the cheapest toothpaste they can find – but there are times when spending a little less makes sense. Maybe you want a spare, maybe you want to drive a Raspberry Pi without unplugging your main keyboard, perhaps you want to try making a macro keyboard, or use it in an environment where other switches are likely to fail. In these circumstances, or if you really don't have the money to spare (in which case, forgive our facetiousness), a membrane board is by far your best bet. Membranical hybrids trend slightly higher in price than your $10 stock membrane, but offer more fancy-pants frippery for the bucks.

Going mechanical is not, even at the base level, what we'd consider cheap, and it's very possible to spiral way out of control with the spending if you start going down the custom switch, custom layout, custom key cap route. Optical, given the extra complexity of its switches, also has a higher price at the low end. So, in this category at least, there can be only one winner.

**WINNER:**
**Membrane**

"Membrane keyboards are, at the same time, just as bad as they ever were and better than they've ever been, depending on if you're buying a cheap one or a more advanced membranical model."

Membrane: Cheap, quiet, easy to manufacture, and boring to type on.

Optical: Based on a mechanical switch, but with more lasers.

## Round 4

**LIGHTING**

RGB seems to be most prominent in the mechanical domain, but many physical switches aren't particularly friendly toward it. Glance at the average mechanical board, and where the key labels are on each key – chances are, they're off-centre, pushed toward the upper edge of the key, because their LEDs have been pushed out by the switch mechanism. There are some varieties that negate this (Logitech/Omron's Romer-G switches, for example, which we love, but others aren't so keen on) by creating a hollowed-out mechanism that puts the LED at its core for central labeling; this reduces the light-flooding that base-mounted LEDs put out, which is either a boon or a curse, depending on your preference for gaudiness.

Credit to the new generation of China-import membrane-mechanical hybrids for bringing the price of solid lighting options down. There's nothing stopping membrane keyboards pulling off the same RGB tricks that mechanical boards can – and examples such as the Razer Deathadder Chroma do just that. Optical isn't left out: even though its switches rely on light for actuation, just about every example we've seen manages strong out-of-switch illumination.

**TIE: Mechanical, Membrane, Optical**

## Round 5

**RELIABILITY**

Keyboard manufacturers love to crow about the number of activations their switches can pull off. Usually, this is meaningless. What happens after that? Do they combust? Turn to dust? Stop working? Even the most prolific typist or gamer is unlikely to get to the multi-million press mark before their next keyboard upgrade, so few of us find out the truth. What we do know is that mechanical switches have the quickest route to failure, as they rely on precise interaction between their moving parts.

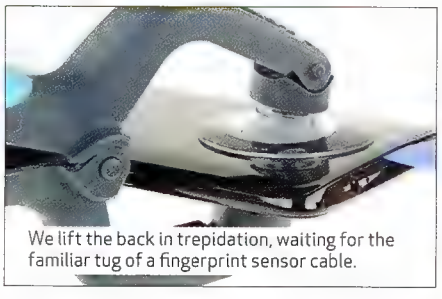
Optical switches, presuming they don't get caked in dust or use defective sensors, should last the longest, as their actuators will live on even after the mechanical portion of the switch has ceased to function properly. Membrane, as long as the circuit sheet remains intact and the contact points remain un-crumbled, isn't short-lived either. Perhaps the better metric, considering that many optical and mechanical keyboards allow you to replace the keys, is what these keyboards can withstand – and while we'd be tempted to give membrane the win, given the existence of silicon-coated rollable keyboards that will work when submerged, we're shuddering at the thought of them.

**TIE: Mechanical, Membrane, Optical**

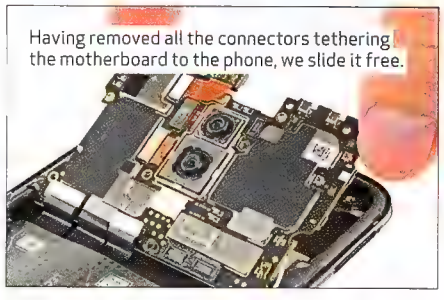
## And the winner is...

We're excited by the potential of optical keyboards to change the way we type. The fast switches and open design space are hugely interesting, and analog sensitivity has a lot of potential – as does the ability to assign more than one function to a key, depending on how far down it's pressed, as with the Wooting One. But while we've said that price shouldn't be a consideration, the fact is that, right now, mechanical keyboards offer more variety for less money, or more customisation if your pockets are deep enough. Membrane keyboards are, at the same time, just as bad as they ever were and better than they've ever been, depending on if you're buying a cheap one or a more advanced membranical model. But we're enthusiasts, and we're typists and gamers, and there's still no real argument: the exact feel you want, the audible experience, the coolest looks, the deepest rabbit hole – they're all still in the mechanical realm. Don't let that stop you from trying something else, but if we were picking up a new keyboard, that's the way we'd go. ■

# howit'sdone



We lift the back in trepidation, waiting for the familiar tug of a fingerprint sensor cable.



Having removed all the connectors tethering the motherboard to the phone, we slide it free.

## OnePlus 6

### Taking this one apart isn't as easy as that equation!

**OnePlus adds one more to its arithmetic-themed line of smartphones. The OnePlus 6 looks pretty good on paper, but how will these fancy specs add up on the teardown table?**

#### MAJOR TECH SPECS

- 6.28-inch Samsung-made AMOLED display with 2,280 x 1,080 resolution (402 ppi), and 2.5D Gorilla Glass 5
- Octa-core, 64-bit Qualcomm Snapdragon 845 processor with 6GB or 8GB LPDDR4X RAM
- Dual main camera with 16MP (f/1.7 with OIS) and 20MP (f/1.7) modules; 16MP (f/2.0) selfie camera
- 64GB, 128GB or 256GB built-in storage
- USB Type-C and 3.5 mm audio ports
- OxygenOS based on Android Oreo 8.1

#### KEY FINDINGS

- An Android phone with a glass back? Thankfully, we've seen this before. The heat gun softens things up, and the iSclack and opening pick take care of the rest. The OnePlus 6 comes with a fingerprint sensor cable long enough to remove the back completely without worrying about tearing the cable.
- We pop off a nice red bracket to free that lengthy fingerprint sensor cable, and spy the NFC antenna. Prior OnePlus antennae did just fine without a glass back (which isn't even for wireless charging), so this glass seems to be just for looks. The friendly green tab on the accessible battery translates to "Pull up and out to remove the battery" not "Battery is not removable" as is written in the corner.
- Nine Phillips screws bite the dust and the plastic antenna frame doesn't budge. But a secret 10th screw behind a liquid damage indicator grants access. Under the plastic midframe, we get up close and personal with the oversized slider mechanism. The button moves a hefty metal plunger, which flips a mechanical switch soldered to the motherboard.
- There are silicone seals around all the flex cable sockets — as found on the OnePlus 5 and every iPhone since the 6s. At the other end, under the loudspeaker assembly, we find more gaskets around the speaker grille, USB Type-C port, and modular headphone jack. Good to see OnePlus go for gaskets over goo, making disassembly and reassembly a snap.
- Although a dual rear camera setup first emerged on the OnePlus 5, this OnePlus includes OIS — a feature we haven't seen since the OnePlus 3T. Coupled with the new IMX519 sensor from Sony, this is a significant step up. Alongside it resides the 20MP Sony IMX 376K sensor, returning from the earlier OnePlus 5T. The selfie cam gets the 16MP IMX 371, which has been in circulation since the OnePlus 5 days.
- Returning to the bottom edge, we flip out a daughterboard and survey what's left in the chassis. The OLED panel is firmly glued in place; it probably won't come out undamaged. You'll likely only be removing a broken display, of course, but the procedure for doing so sure isn't repair-friendly.
- **Repairability score:** 5 out of 10 (10 is easiest to repair). The battery is only lightly adhered in place, plus there's a convenient pull tab. Many components are modular and can be individually replaced. All the threaded fasteners are standard Phillips. Display replacement is not prioritised in the design and will take a lot of work. Front and back glass means twice the risk of cracks. The primary access point for all repairs is heavily glued in place. ■

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# epinions

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## TURNING THE SCREWDRIVER JAPANESE

Just writing in to say thanks for the PC Builder's Bible feature in the May 2018 issue (see APC #454, page 48). I've been building custom rigs for my family and friends for nearly 30 years, and I still learned a lot from your article. (Magnetic bowl! D'oh! I feel so stupid...)

One thing hit me in the 'Tools of the trade' item (apart from not mentioning wire-cutters) and that was the mention of a 'good old trusty Phillips head screwdriver'. Apparently, the Japanese do not use the terms 'Phillips-head' or 'flat-head'. They refer to their tools as 'plus' and 'minus' drivers respectively. I find these such unambiguous and efficient definitions that, once learned, they're impossible not to use... and just think of the column space you could save. **Stuart McCormack**

## ONE UPDATER TO RULE THEM ALL

Thanks for producing a great magazine. I'd just like to make a comment on the '25 Best Windows Apps' in *APC*'s April issue (#453, see page 62).

In the section 'Keep apps up to date' on page 66, Nick Peers makes reference to the Secunia PSI product. It's a free product I have used for many years, but unfortunately, the company who purchased Secunia decided to discontinue support for the PSI product. As of April 20th (I think), Secunia PSI is no longer receiving updates and is no longer officially supported. That's a great pity, as it was a simple and effective product.

Security articles are always mentioning to keep your PC up to date with the latest patches, and that's fine for the operating system, but what about the majority of applications that are installed, such as Adobe Reader and Flash Player, VLC Media Player, Apple iTunes and so on? This is where Secunia PSI was a great product in not only telling you that an installed application, wasn't the latest version available, but also that an installed application was end of life. Secunia PSI also used to inform me when my Nvidia video drivers needed to be updated.

> **"Apparently, the Japanese do not use the terms 'Phillips-head' or 'flat-head'. They refer to their tools as 'plus' and 'minus' drivers, respectively."**

I'm not sure what other products are available that could replace Secunia PSI, but it would make a good article, as it's an area that all Windows, Apple or Linux users need information about. **Simon Blasterfield**

**Ed replies:** *Secunia PSI has indeed been discontinued since we recommended it in our April issue and yep – finding a good alternative has been difficult. The best one we've found isn't free like PSI was, sadly – that's KC Softwares' SUMo (**kcsoftwares.com**), which costs €29.99. The best completely-free replacement we've come across is Patch My PC Updater (**patchmypc.net**), although it sadly doesn't seem to discover nearly as many apps when scanning your PC as SUMo does. You could also try Filehippo Update Checker (**filehippo.com**), although it only supports applications that are held on the eponymous download site.* ■

APCMAG@FUTURENET.COM

## Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

# Your health history will be available online in October, unless you opt out

With an update to My Health Record imminent, many are wondering whether the government can be trusted with their personal information, Shaun Prescott writes.

**It's been just over a year since reports emerged that Medicare card details were being sold online. Dubbed 'The Medicare Machine', the darkweb storefront made it possible to obtain the details of any Aussie citizens on Medicare's records for a mere $30. According to the vendor, they were "exploiting a vulnerability which has a much more solid foundation which means not only will it be a lot faster and easier for myself, but it will be here to stay."**

Barely a year later, the Australian Government is set to re-launch its online health agency My Health Record (MHR). Previously an opt-in system when it was introduced in 2012, the medical history database will become an opt-out system from October 15, thanks to legislative amendments made in 2015. The site will provide an overview of all medicines you've been prescribed, all treatments you've received, and all allergies or illnesses you suffer from. Of course, this is not publicly available and one can only assume that some pretty serious measures are being taken to keep it secure. But given its track record, it's difficult to trust that the government can keep the lid on it all.

And that's before you consider who can *legitimately* access these records. According to the parliamentary library, MHR "represents a significant reduction in the legal threshold for the release of private medical information to law enforcement". Currently, without the consent of a patient, law enforcement agents are required to have a warrant, subpoena or court order in order to access medical records. And yet, according to the My Health Records Act 2012, the organisation responsible for the records, Australian Digital Health Agency, can provide this information in order to counter "seriously improper conduct". It can even do so to "protect the public revenue".

So a government that's demonstrably untrustworthy when it comes to cybersecurity is making it easier for police to access personal information it would previously need to struggle to obtain. When faced with news like this, many are inclined to say: "Well, I don't break the law, so it doesn't affect me." But if it weren't for advocates and interest groups, news of the forthcoming opt-out nature of MHR probably wouldn't have reached us. In other words, it doesn't matter whether you're breaking the law or not. What matters is that the government is making sweeping privacy changes like this without any broad consultation with the public.

Privacy advocates are warning everyone to opt-out of MHR before it switches over in October. But there are some well-meaning organisations calling for the opposite to happen. While it's naturally in the interests of the ADHA to do so, other medical bodies such as the Australian Medical Association, the Royal College of Australian GPs, and more, have backed the online database. It'll make life easier in the medical world, but whether you can trust government organisations with handling your data online is a very fair question. ■

END USER

## Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

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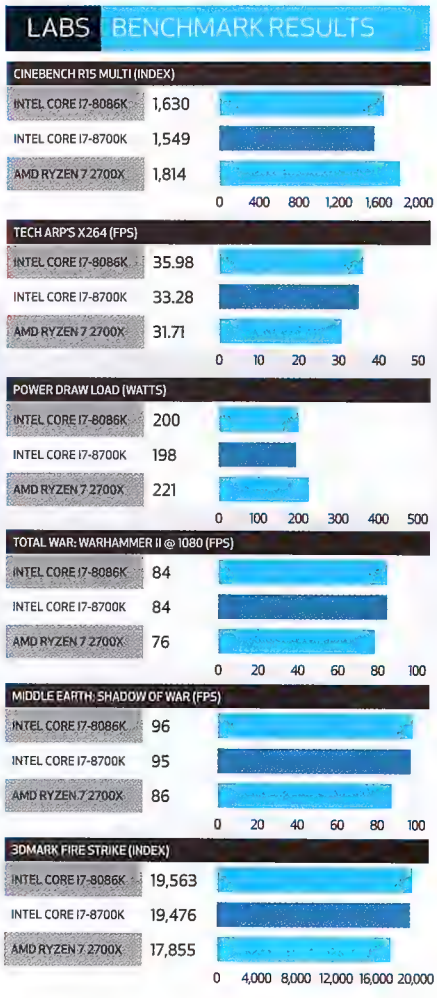
LABS BENCHMARK RESULTS
CINEBENCH R15 MULTI (INDEX)
INTEL CORE I7-8086K 1,630
INTEL CORE I7-8700K 1,549
AMD RYZEN 7 2700X 1,814
0 400 800 1,200 1,600 2,000
TECH ARP'S X264 (FPS)
INTEL CORE I7-8086K 35.98
INTEL CORE I7-8700K 33.28
AMD RYZEN 7 2700X 31.71
0 10 20 30 40 50
POWER DRAW LOAD (WATTS)
INTEL CORE I7-8086K 200
INTEL CORE I7-8700K 198
AMD RYZEN 7 2700X 221
0 100 200 300 400 500
TOTAL WAR: WARHAMMER II @ 1080 (FPS)
INTEL CORE I7-8086K 84
INTEL CORE I7-8700K 84
AMD RYZEN 7 2700X 76
0 20 40 60 80 100
MIDDLE EARTH: SHADOW OF WAR (FPS)
INTEL CORE I7-8086K 96
INTEL CORE I7-8700K 95
AMD RYZEN 7 2700X 86
0 20 40 60 80 100
3DMARK FIRE STRIKE (INDEX)
INTEL CORE I7-8086K 19,563
INTEL CORE I7-8700K 19,476
AMD RYZEN 7 2700X 17,855
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# Intel Core i7-8086K

## A celebratory CPU that proves speed is still king.

**Where do we even begin with this? For those who are already on Intel's 8th-gen platform, the 8086K processor simply doesn't make any sense. In short, it's a pre-binned Intel Core i7-8700K, released to commemorate the 40th anniversary of the x86 architecture. There's a limited run of them – around 50,000 in total – and that's all there really is to it. There's nothing new here. Apart from the guaranteed 5GHz turbo out of the box, of course.**

However, this CPU is nothing short of awe-inspiring. It's a phenomenal piece of history, and it tells a story. It takes the very best of what Intel can muster today, skimmed from the top of those 8700K silicon wafers, and honours its predecessors from the last 40 years of processor development, across both AMD and Intel. From 29,000 transistors on a 3,000nm process in an area 33mm² to around 5.6 billion transistors (rough guess – Intel doesn't make it public anymore) using a 14nm process, with a die that's 151mm², the last four decades of CPU evolution have been incredible. To give you some perspective, if that were represented on an *APC* bar chart, it would be an improvement of 19,310,245%.

At stock, the 8086K scored 212 points in Cinebench R15 single, versus the Core i7-8700K's 203; 1,630 in multi versus 1,549; and it completed Fry Render in 128 seconds, compared to the 8700K's 133. Power draw under load was 2W higher than its lower-clocked sibling, and that's about it. So, at stock, it's undeniably a better processor, but for $100 more? Hmm, not sure.

What's so impressive about it, then? It's that untapped potential inside. At stock, the Core i7-8700K and the 8086K have very similar turbos – both max out at 4.3GHz across all six cores, with the 8086K taking the lead on the single core running at 5GHz instead of 4.7GHz. By just adjusting the multiplier, you can easily get 5GHz across all the cores.

At stock, under load, it easily hits around 82°C with a 360mm AIO. Try to aim for something like 5.3GHz, and you'll run straight into that 100°C TJMax. That said, 5.2GHz across all six cores is still a 900MHz increase, and pumps out some impressive numbers, too, even if you're skirting around that 90°C mark, with 1,682 points in Cinebench R15 multi, and 218 single-core.

But we knew our 8086K had more to give. So we took the chip, grabbed our trusty Der8auer Delid Die Mate, took the heat spreader off, and replaced the thermal paste with some Thermal Grizzly Conductonaut Liquid Metal, before gluing it all back together. The result? Temperatures at 5.2GHz dropped from 90°C down to 71°C. We then pushed for 5.3GHz again, this time upping the voltage to 1.44V, and benchmarked it, with temps reaching 80°C on the hottest core. The chip was stable, and achieved 1,713 points in Cinebench R15, and 229 on the single core. We knew from the industry that only the top 14% of 8086Ks could achieve that frequency, but the itch to go further was still there. Our final overclock was achieved at 5.4GHz across all six cores, at 1.48V. It scored an incredible 1,753 points in Cinebench, and 233 points single-core, with a max package temp of 86°C. To be honest with you, it probably has more to give, but we just don't have the cojones to push it any harder.

Is it for you? Well, it's not a smart choice, for sure, but it's certainly a satisfying one. ■ **Zak Storey**

## Verdict

Features ★★★★★
Performance ★★★★½
Value ★★★½

**Incredible potential performance, this is the perfect overclocking chip, but not for everyone.**

★★★★½

INTEL Z370 MOTHERBOARD

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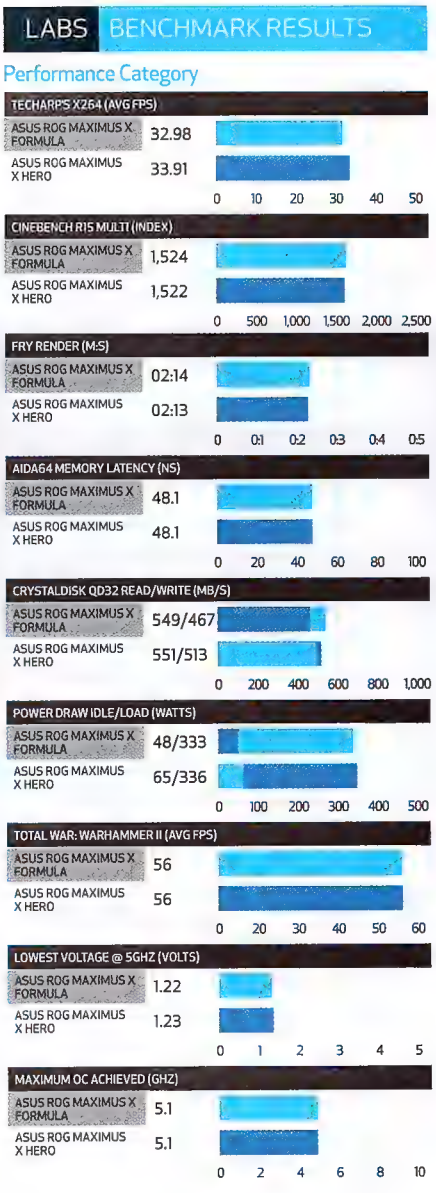
# ASUS ROG Maximus X Formula

## We've been taken to 10th-gen heaven.


LABS BENCHMARK RESULTS
Performance Category
TECHARPS X264 (AVG FPS)
ASUS ROG MAXIMUS X FORMULA 32.98
ASUS ROG MAXIMUS X HERO 33.91
0 10 20 30 40 50
CINEBENCH R15 MULTI (INDEX)
ASUS ROG MAXIMUS X FORMULA 1,524
ASUS ROG MAXIMUS X HERO 1,522
0 500 1,000 1,500 2,000 2,500
FRY RENDER (M:S)
ASUS ROG MAXIMUS X FORMULA 02:14
ASUS ROG MAXIMUS X HERO 02:13
0 0:1 0:2 0:3 0:4 0:5
AIDA64 MEMORY LATENCY (NS)
ASUS ROG MAXIMUS X FORMULA 48.1
ASUS ROG MAXIMUS X HERO 48.1
0 20 40 60 80 100
CRYSTALDISK QD32 READ/WRITE (MB/S)
ASUS ROG MAXIMUS X FORMULA 549/467
ASUS ROG MAXIMUS X HERO 551/513
0 200 400 600 800 1,000
POWER DRAW IDLE/LOAD (WATTS)
ASUS ROG MAXIMUS X FORMULA 48/333
ASUS ROG MAXIMUS X HERO 65/336
0 100 200 300 400 500
TOTAL WAR: WARHAMMER II (AVG FPS)
ASUS ROG MAXIMUS X FORMULA 56
ASUS ROG MAXIMUS X HERO 56
0 20 30 40 50 60
LOWEST VOLTAGE @ 5GHZ (VOLTS)
ASUS ROG MAXIMUS X FORMULA 1.22
ASUS ROG MAXIMUS X HERO 1.23
0 1 2 3 4 5
MAXIMUM OC ACHIEVED (GHZ)
ASUS ROG MAXIMUS X FORMULA 5.1
ASUS ROG MAXIMUS X HERO 5.1
0 2 4 6 8 10

**Formula boards are the kings of ASUS's consumer lineup. Consider it a luxury and the 10th iteration of this design ethos has lead to this: a $639 masterpiece of connectivity, rear I/O, BIOS, liquid-cooling, and armour-plated PCB. And it looks marvellous.**

That thermal armour – which was introduced with the TUF series, way back in the Z77 era – is hardly a new concept, and whether it actually reduces overall stress and temps on the PCB is still highly debated. That said, there's no denying just how impressive this thing feels in your hands.

RGB lighting is subtle, with only four illuminated zones: the now-standard one baked into the rear I/O cover, one outlining the integrated on-board power and restart buttons, one embedded into the chipset heatsink, and the last ones at the ends of each PCIe slot, to give them a little extra pop. It's quite a departure from the trend we've seen over the last few chipsets, and it's far less gaudy.

There's good reason for that. The Formula's true party piece is the OLED display fixed to the middle, just south of the CPU socket. At boot, this small two-inch hexagonal panel shows off the BIOS debug codes your system's cycling through. It's on login, however, where things get more interesting: Using ASUS's LiveDash software, you can show any number of useful statistics, from CPU temps to voltages, clock speeds, and fan RPMs. If you're feeling fancy, you can throw your favourite GIF on there, or an ASUS logo, all pre-programmed into the LiveDash.

Then, of course, we get to performance. Overall, the Maximus X Formula performs well. Cinebench R15 scored a respectable 1,414 points, with the remainder of our CPU rendering tests falling in line with our other results. One thing that did catch our eye, however, was the seemingly excessive power draw under load. At stock, performing our standard looping 3DMark Fire Strike Extended test, we saw power scores clock up all the way to 333W. Now, that's not huge, not when you think about how taxing that benchmark is, but given the fact it's been some time since we've looked in detail at a Z370 motherboard, it was the stark contrast to its AMD counterparts that really caught our eye – it's 55W higher than the same test on our Crosshair VI Hero with the Ryzen 7 1800X. As that has an additional two cores, it just goes to show how much Intel is struggling with this latest generation of chips.

On top of that, ASUS boards still have problems with the auto CPU voltage being way too high at stock. Registering temperatures as high as 72°C under load with a 360mm AIO, it certainly doesn't feel too comfortable. That said, it does mean you can just throw a ratio at it and be pretty happy. We managed a clean 5GHz without even touching any other settings, although it was drawing 1.3V. Auto-overclock that yourself, and you can get it as low as 1.22V without throttling the chip.

**Zak Storey**

## Verdict

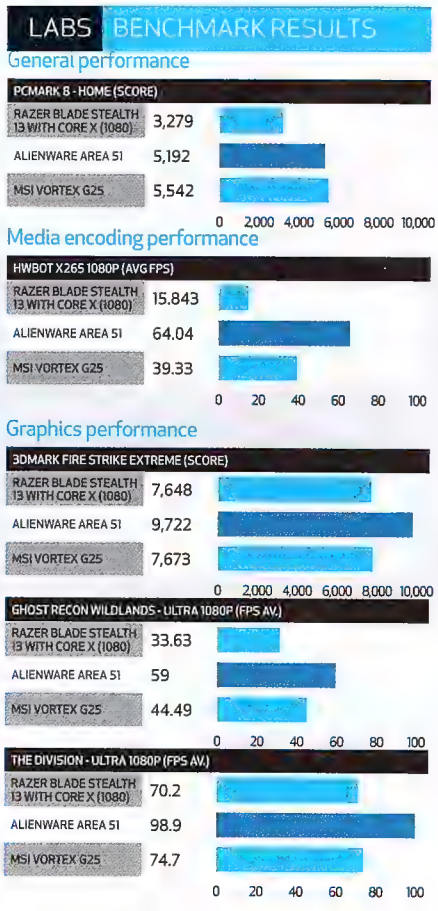
| | |
|---|---|
| Features | ★★★★★ |
| Performance | ★★★★½ |
| Value | ★★★½ |

**Huge connectivity; strong performance; aesthetically impressive; OLED display; backplate, armor, and I/O shield.**

★★★★½

EXTERNAL GPU ENCLOSURE

**$469.95 | WWW.RAZER.COM**


LABS BENCHMARK RESULTS
General performance
PCMARK 8 - HOME (SCORE)
RAZER BLADE STEALTH 13 WITH CORE X (1080) 3,279
ALIENWARE AREA 51 5,192
MSI VORTEX G25 5,542
0 2,000 4,000 6,000 8,000 10,000
Media encoding performance
HWBOT X265 1080P (AVG FPS)
RAZER BLADE STEALTH 13 WITH CORE X (1080) 15.843
ALIENWARE AREA 51 64.04
MSI VORTEX G25 39.33
0 20 40 60 80 100
Graphics performance
3DMARK FIRE STRIKE EXTREME (SCORE)
RAZER BLADE STEALTH 13 WITH CORE X (1080) 7,648
ALIENWARE AREA 51 9,722
MSI VORTEX G25 7,673
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GHOST RECON WILDLANDS - ULTRA 1080P (FPS AV.)
RAZER BLADE STEALTH 13 WITH CORE X (1080) 33.63
ALIENWARE AREA 51 59
MSI VORTEX G25 44.49
0 20 40 60 80 100
THE DIVISION - ULTRA 1080P (FPS AV.)
RAZER BLADE STEALTH 13 WITH CORE X (1080) 70.2
ALIENWARE AREA 51 98.9
MSI VORTEX G25 74.7
0 20 40 60 80 100

# Razer Core X

## Can it really transform your laptop into a desktop-stomping gaming rig?

**With the latest-gen mobile CPUs from Intel now offering six-core CPUs that can fit into super slim ultrabooks, an external GPU (eGPU) accelerator that bolts onto your ultrabook has perhaps never made more sense. Working over Thunderbolt 3 or USB 3.1, Razer's Core X is the company's third eGPU enclosure, and it lets you outsource graphics-heavy tasks from your laptop to a desktop PCIe graphics card – in theory giving even an ultrabook a serious kick in the graphics department. Compared to its forebear, the Core V2, the Core X offers a bigger power allocation, uses the newer Thunderbolt spec and comes at a significantly cheaper price.**

The release of the Core X also neatly lines up with a new macOS feature that arrived in March 2018, which provides official support for a number of AMD desktop GPUs using an Apple-approved eGPU enclosure, including the Core X. This means existing MacBook Pros can be boosted by combining an AMD Radeon (or Radeon Pro) GPU with the Core X for a serious GPU bump.

The 6.4kg Core X is roughly the size of a mini-ITX PC tower and comes wrapped in a thick piece of curved aluminium which, while it looks impressive, also makes up at least half of the unit's weight. Folded inside this premium frame is a 650W power supply that can run GPUs up to 500W, a PCIe-equipped daughter board with a Thunderbolt connection, and a large 120mm cooling fan. That's basically all the parts you need to turn your daytime ultrabook into a nighttime gaming godfather. You'll have to BYO desktop GPU and slot it inside the cooling frame, but the Core X is compatible with the last three generations of Nvidia GTX GPUs, Nvidia's Quadro workstation range and AMD's Radeon R9, RX and WX graphics cards, so you shouldn't have any trouble finding something.

For testing, we installed a GeForce GTX 1080 in the Core X and paired it with a 13-inch, 2018-model Razer Blade Stealth ultrabook equipped with a Core i7-8550U CPU and 16GB of RAM. On 3DMark's toughest graphical benchmark, that combination pushed out a solid score of 4,306, around 15% less than what you'd expect from a similarly-equipped desktop PC using a GeForce GTX 1080. However, those synthetic benchmark numbers didn't quite hold up in real-world testing. At 1080p resolution with Ultra graphics settings, frame rate averages were of just 33.63fps on modern titles like *Ghost Recon Wildlands* – around half the 59fps what we saw with our GTX 1080-equipped desktop. While not everything dropped that far, we did note GPU performance sacrifices 40–50% in many games – a tough pill to swallow if you've forked out for a top-shelf GTX 1080.

The Thunderbolt 3 connection is the main bottleneck. Other tests show the performance loss is much lower with entry-level or midrange GPUs. While you can boost performance on faster cards by about 10% if you connect an external monitor directly to the GPU output, even that's not quite enough to make this a universally appealing solution to the conundrum of gaming on an ultrabook. We await the release of Thunderbolt 4 with bated breath. ■ **Joel Burgess**

### Verdict

| | |
|---|---|
| Features | ★★★½☆ |
| Performance | ★★★☆☆ |
| Value | ★★★★☆ |

Not a complete win, but it is a reasonably priced eGPU that can deliver modest gaming speed for ultrabooks.

★★★½☆

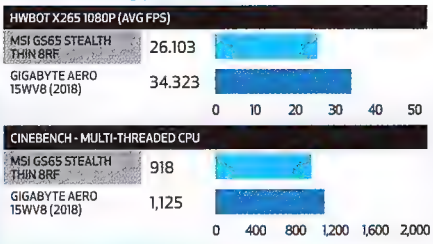
GAMING ULTRABOOK

$3,399 | AU.MSI.COM

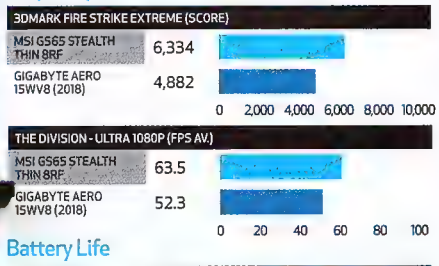
LABS BENCHMARK RESULTS

General performance

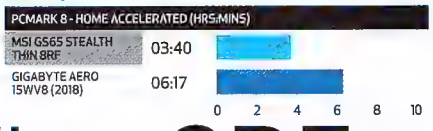
Media encoding performance




Graphics performance




Battery Life




# MSI GS65 Stealth Thin 8RF

## MSI puts on it's Sunday best in it's latest ultra-thin gaming notebook.

**MSI's new GS65 Stealth Thin is unlike anything we've ever seen before from the Taiwanese laptop maker. This 1.8cm-thick unit ditches the usual brushed metal 'gaming' facade for a laser cut near-unibody metal case that's hemmed with a gold beveled top-edge. This compact square and slim profile is garnished with a mixture of fractally perforated air inlets and two architecturally inspired exhaust vents that look great, and also represent a largely re-engineered thermal design that pays serious performance dividends. The GS65 even has the first MSI trackpad we've been genuinely impressed by and while the keyboard is a little softer than we'd like, it's serviceable for a device this thin.**

Up front is a speedy 15.6-inch 144Hz Full HD IPS display that squeezes into a 14-inch form factor, with an Intel Core i7-8750H CPU, 16GB of RAM, 512GB PCIe SSD, 80Wh battery and a Nvidia Max-Q GTX 1070 GPU inside.

The GS65 Stealth Thin 8RF has some pretty direct competition in Gigabyte's 2018 Aero 15 (reviewed back in issue 454, page 24) which shares the same CPU, RAM and screen configuration, but swaps in a lower specced GTX 1060 GPU and a slower SATA 6Gbps SSD and a longer lasting 94Wh battery for a $450 discount. Obviously, the GPU difference is simply a matter of choice in this instance, but it's a tough call as to whether we'd go for better battery life or a faster SSD on this type of device.

Naturally, these two systems perform similarly well in general CPU-heavy home and work tasks, despite the fact that the Gigabyte unit seems to have lucked out with a higher performing CPU, clocking a single-core Cinebench R15 score of 178 to the GS65's score of 168. Across six cores, this difference manages to compound to between 17% and 23% better scores in HWBot 1080p encoding benchmarks, considerable from what is supposed to be an identical chip.

Graphical performance shows the other side of the coin, however, with MSI's GS65 Stealth Thin 8RF performing between around 25% better on 3DMark benchmarks and between 10 and 18% better on real-world gaming tests than the Aero 15's GTX 1060 GPU. That faster PCIe connected SSD that we talked about earlier happens to be a second generation NVMe drive that reads and writes at 2,515.5 and 2,028.1MB/s respectively, which is between four and five times faster than the Gigabyte Aero 15's SATA 6Gbps SSD.

A combination of enhanced fan blade design and the re-engineering of heat pipe, sink and vents keep the unit's thermals at a near optimum temperature, with the CPU never spiking over 95°C and the GPU keeping under 87°C. We were particularly impressed by this when we learned that the GS65 Stealth Thin was a millimeter thinner and 160g lighter than the Aero 15, despite having a faster GPU. While the movie playback battery life of the GS65 is less than the Aero 15 — 6 hours and 20 minutes rather than 7 hours and 8 minutes — that's still a great result for such a powerful gaming laptop at this size. At $3,399, the GS65 is also reasonably priced for everything that's included.

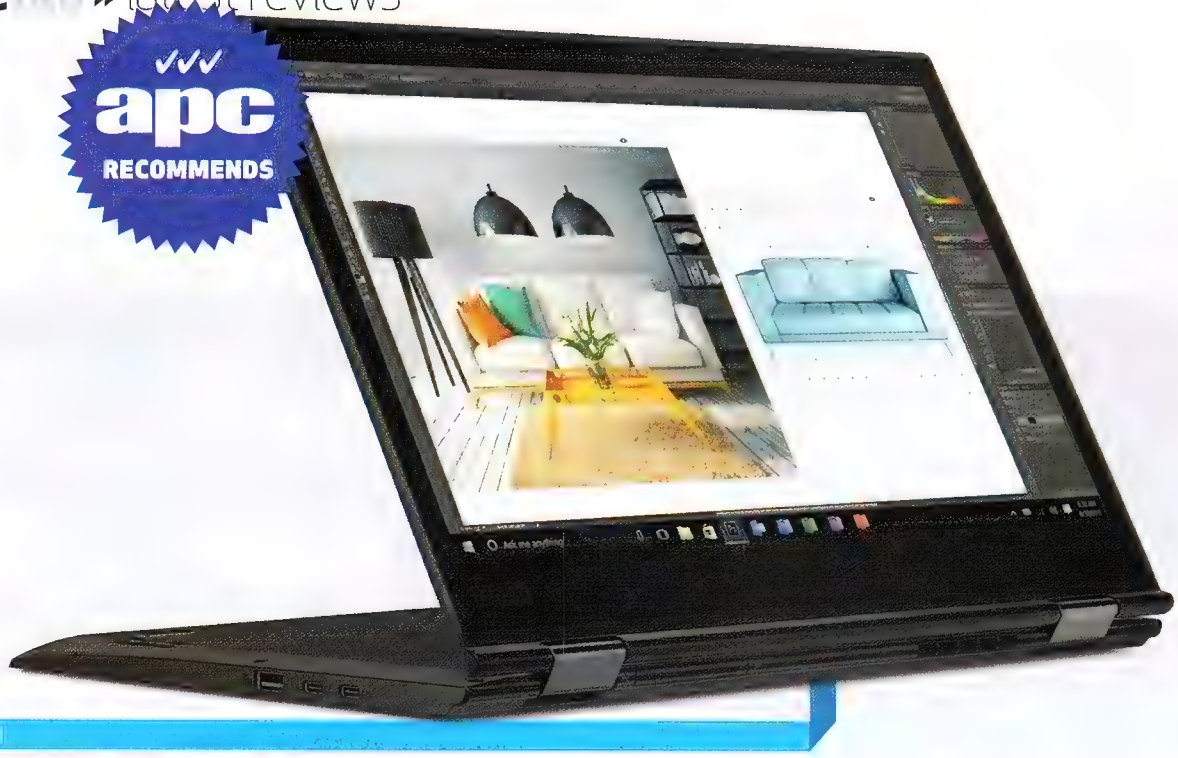
**Joel Burgess**

### Verdict

| | |
|---|---|
| Features | ★★★★★ |
| Performance | ★★★★★ |
| Value | ★★★★½ |

**This gaming ultrabook is not only MSI's best dressed, it's also a gaming workhorse that comes at a fair price.**

★★★★★




**FROM $2,499 | WWW.LENOVO.COM/AU**

# Lenovo ThinkPad X1 Yoga (3rd gen)

## The ThinkPad X1 Yoga qualifies for yet another upgrade.

**Lenovo's ThinkPad range has always been about high-end performance, resilience and reliability and this third-generation ThinkPad X1 Yoga is no exception. It combines the latest Intel silicon and NVMe storage with a 2-in-1 design that offers laptop and tablet functionality in a flexible package.**

The price we quoted above will get you a Core i5 CPU, a less impressive display and SATA storage. The headline cost of $2,999 for the high-end model puts it in direct competition with the Microsoft Surface Pro, HP Spectre x360 and Dell Latitude 7285.

For the money, you get an elegant machine with a slick matte black or silver finish plus the signature red dot motif. The case is made from a carbon-fibre hybrid material that offers durability and strength while remaining lightweight at 1.4kg.

Opening the lid presents you with a very clean working space, dominated by a touchpad.

The 'Wave' keyboard cleverly retracts the keys when the laptop is closed, and they also do this when the hinge passes 190° for tablet use. The 'Wave' design makes the keys stand proud of the base, giving extra travel when typing.

Thanks to its ultra-slim 2-in-1 design, Lenovo has also arranged the active ports along the sides of the machine. Two USB Type-C Thunderbolt 3 ports sit on the left hand side, offering both peripheral connection and laptop charging. A slimmed-down WAN port with an included adapter for connecting to wired networks is also included. Behind a thin removable cover on the rear, you'll find the phone SIM and microSD card slots.

Since this is a 2-in-1 laptop with tablet use in mind, the ThinkPad X1 Yoga also comes with a Wacom-designed active stylus.

As you'd expect given the price, the ThinkPad X1 Yoga is fully kitted out with Intel's new Kaby Lake R-series CPUs, which offer four cores and eight threads, yet have a maximum power profile of just 15W.

Booting Windows and launching apps is practically instantaneous, and the only time the X1 Yoga isn't highly responsive is when Windows has initiated some background upgrade exercise without asking.

Indeed, this hybrid's only weakness is the integrated Intel UHD Graphics 620 GPU, which doesn't contribute enough, considering the raw computing power that is pushing it.

The drive is a Samsung PM981, an NVMe PCIe unit which pumps out solid read and write speeds of around 2,200MB/s and 1,100MB/s respectively..

A calibration test also revealed that the exceptionally crisp 2,560x1,440 IPS display could represent the full 100% of sRGB and AdobeRGB colour gamuts. Combine that with a static contrast ratio of over 1,000:1 and 463-lumens brightness, and you have a quality display

So it's a shame,then, that battery life isn't quite as stunning as Lenovo likes to claim.

Our PCMark 8 benchmark revealed that the X1 Yoga lasted just 4 hours 18 minutes in our high-performance Work test; and 6 hours 24 minutes in power-saving mode — a country mile short of the 15 hours of battery life quoted by Lenovo. Unless you never stop work and never answer the phone, the longevity you'll get is probably a working day, but only just.

Still, at least it recharges very quickly, having RapidCharge technology that can get the device back to 80% capacity in just 60 minutes. ■

### Verdict

| | |
|---|---|
| Features | ★★★★½ |
| Performance | ★★★★ |
| Value | ★★★★ |

**This X1 Yoga impresses with its design and slick performance, but is let down by limited battery life.**

★★★★☆

apc RECOMMENDS

LAPTOP

**FROM $2,800 | WWW.HP.COM/AU**

# HP EliteBook 840 G5

## Performance for power users.

**The EliteBook offers a very wide range of performance and price points, with the 840 G5 being on the higher end of that sliding scale. The first thing that strikes you about the G5 is how well made it is, without it falling into the obvious trap of over-engineering; the chassis avoids any sharp edges or flexible structures. The top lid is metal skinned and feels invitingly cool to the touch, while the underside is plastic and less visually appealing.**

Opening the G5 reveals a spacious backlit keyboard. The touchpad is of the highest quality, has both buttons at the top, with more under an edge at the bottom, and it's compatible with Microsoft Precision Touchpad gestures.

In terms of ports, on the left is a single USB 3.1 Gen 1 port, another on the right, plus a single Thunderbolt Type-C, HDMI 1.4b, RJ-45 Ethernet, a 3.5mm headphone/mic combo, and a proprietary docking connector.

For us, the best aspect of the 840 G5 is undoubtedly the screen. Depending on the model, there are no less than 11 different panels offered on this chassis, including a single 4K option. The others have 1080p IPS displays that have 220, 400 or 700 nits of backlighting. The variances beyond resolution are grouped by the inclusion of touch, the camera spec and an optional ambient light sensor. Our review machine was blessed with a 1,920 x1,080 Full HD, 700 nits, ultra-slim display with the HP Sure View privacy mode and HD+IR camera. This is one of the best displays we've seen on an ultrabook yet, giving you a clear view under almost any lighting condition.

HP has also included Bang & Olufsen speakers that kick out significantly more bass frequencies than we expect from a laptop. Plus, our variant came with an 8th-gen quad-core Intel Core i7-8550U processor that can Turbo Boost to 4GHz, plus a lightning-fast 512GB NVMe SSD.

Our only reservation about the EliteBook is that HP insists on using a proprietary power connector when this machine has a Type-C Thunderbolt port that could be made dual-purpose.

In the performance arena, the G5 is remarkably quick and agile. Combining such a new and powerful Core i7 series CPU with high-end NVMe storage is a recipe for raw speed not normally associated with portable PCs. It isn't a cheap device, and it certainly doesn't perform like one either. Any task involving 3D graphics is undermined by the mediocre Intel UHD 620 GPU, but by all other measures, this system soars.

Easily the most impressive benchmarks concern the storage speed. HP uses a 512GB Samsung PM981 NVMe drive in this machine, and it reads and writes a breathtaking amount of data per second – 3,239.9MBps (read) and 2,095.4 MBps (write) using CrystalDiskMark.

Unless you are looking to game or run CAD, and therefore need a discrete GPU, there is plenty of power here. If you're only going to use this laptop occasionally, all that power if overkill.

The battery managed to run for 4 hours, 54 minutes with full performance mode. Setting Windows 10 for 'best battery life' easily extends that past 10 hours. In real-world terms, that's a full working day and some extra, unless you do computing-intensive tasks.

Compact, yet massively powerful and feature-filled, the HP EliteBook 840 G5 avoids design showboating and focuses entirely on providing the best core user experience. ■

### Verdict

Features ★★★★½
Performance ★★★★
Value ★★★½☆

Aimed at power users, the HP EliteBook 840 G5 crams the latest tech into a well-made package.

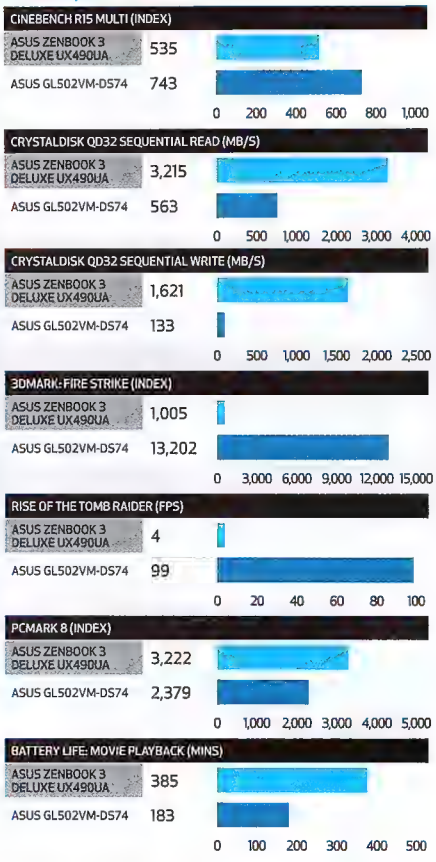
★★★★☆

LAPTOP

**$2,599 | WWW.ASUS.COM/AU**

LABS BENCHMARK RESULTS

General performance


CINEBENCH R15 MULTI (INDEX)
ASUS ZENBOOK 3 DELUXE UX490UA 535
ASUS GL502VM-DS74 743
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CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)
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RISE OF THE TOMB RAIDER (FPS)
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PCMARK 8 (INDEX)
ASUS ZENBOOK 3 DELUXE UX490UA 3,222
ASUS GL502VM-DS74 2,379
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BATTERY LIFE: MOVIE PLAYBACK (MINS)
ASUS ZENBOOK 3 DELUXE UX490UA 385
ASUS GL502VM-DS74 183
0 100 200 300 400 500

# ASUS ZenBook 3 Deluxe UX490UA

## Super-thin and light, but stumbles if heavy lifting.

**Ultrabooks may have been with us for over six years now, but it still feels like we haven't quite hit the perfect balance of performance in a slimline package. The ASUS Zenbook range gets close with bang up-to-date components, and an even sleeker chassis.**

The headline component on the spec sheet is the processor, and in this machine that's just half an inch thick, you'll find a quad-core, eight-thread Core i7-8550U (Kaby Lake R). This chip has a base clock of 1.8GHz, but generally runs quicker, thanks to the joys of turbo boost. But how much it boosts is a bit of a contentious affair: Intel says it'll peak at 4GHz, ASUS says it'll run at anything up to 3.7GHz, while in testing we witnessed it reach 4GHz under heavy workloads (our benchmarks).

This does lead to our biggest problem with the ZenBook 3 Deluxe, though – that 4GHz peak saw the processor temperature hit 100°C, which lead to it throttling back to keep the thermals down. Run benchmarks multiple times in quick succession, and your figures quickly tank, with subsequent results coming in far lower than the last – we recorded a Cinebench R15 score of 450 after a particularly hard benchmarking session; over 20% lower than its highest score. Obviously, you're not going to push a machine like this so hard on a day-to-day basis, but by the same token, you'd be better off settling for a lesser CPU that isn't constrained by the thermal envelope it finds itself operating inside.

Test the storage, though, and you'll see that this thing flies. There's nothing new about PCIe NVMe SSDs, but laptops still tend to go for SATA drives to keep prices down, so it's refreshing to throw files around on here. Installations are speedy, file copying a breeze, and Windows is smooth in operation. ASUS doesn't brag about what drive is being used, although a bit of snooping reveals that it's a Samsung PM961 hiding inside. 512GB is plenty of room for most uses, although you may need to grab an external drive for some workloads, but don't forget that this is USB-C territory (though a USB-A/HDMI dongle is included).

The rest of the specification is reassuringly punchy, with 16GB of LPDDR3 RAM giving your applications plenty of room to work with. The screen is worth spending a bit of time with, because it looks incredible whether you're working, playing back a movie, or trying to enjoy some low-powered gaming. (You're going to be hard pushed to hit playable frame rates in modern games, even with everything set as low as possible.) The Harmon/Kardon audio is reasonable enough, given its thickness, although it isn't going to challenge a decent set of cans. One oddity here is the webcam – it's merely a VGA model, which seems a bit off given the rest of the specs.

All up, this is a terrifc machine, and one of the most impressive Windows laptops you can currently lay your hands on.

**Alan Dexter**

## Verdict

Features ★★★★½
Performance ★★★★½
Value ★★★★

**Super-thin and light design; gorgeous screen; comfortable keyboard and touchpad; strong performance.**

★★★★½

LAPTOP

**$1,099 | WWW.LENOVO.COM/AU**

# Lenovo V330-15IKB

## Dying the death of a thousand cost cuts...

**Lenovo's V Series are laptops for those of us who want the latest technology, but can't stretch to an ultrabook or 2-in-1 equivalent design. The low cost and high spec approach has been highly popular before, can it be so again? Here we're taking a look at the Core i5-powered Lenovo V330.**

It looks the biz, finished in Iron Grey high gloss plastic with a brushed metal-skinned lid. It also comes in a lighter Mineral Grey.

The 15-inch form factor allows plenty of space for the keyboard, touchpad and the side-placed ports, and optical drive, avoiding the cramped nature of smaller devices. At 2.05kg it isn't the lightest machine to carry around.

The V330 has an excellent selection of ports, too: HDMI, VGA, two USB 3.0 ports, Ethernet, an SD Card slot and an audio combo jack. It also has two USB Type-C ports, one of which offers Thunderbolt, DisplayPort and PowerDelivery.

Opening the lid reveals a keyboard with decent-sized keys and good spacing between them. The membrane key action is a little light, but a reasonable speed of entry is easily within grasp.

What is likely to cause more problems is the touchpad, which has no visible buttons. You can gesture left or right mouse clicks, but the front edge has switches under it that perform the same function if you press hard enough.

Budget machines often use previous generation silicon to reduce production costs, but the V330 uses the very latest Intel parts. To offset that, Lenovo has taken an axe to other components, making for an oddly unbalanced design – with an eighth-generation Core i5 processor at on the one end, and a 5,400rpm hard drive at the other.

Sadly, there is a sluggishness to this PC that's the direct result of it using a hard drive rather than an SSD. Without that one part, this machine would perform better than the majority of budget laptops, considering how effective the Intel Core i5-8250U quad-core 1.6GHz CPU can be.

The speed of this machine is in the same ballpark as others built using this chipset and processor option, possibly the most prevalent choice for laptop designers currently.

Sacrifice space for speed (and save about $130) and go for the model with a 256GB SSD. Otherwise, there's little point in getting a Core i5 or i7 either, since their abilities are masked by the slow storage speed.

The V330 also disappoints when it comes to battery life. Lenovo quotes a six-hour running time, but we didn't get near that level in our tests. Using PCMark08 Work test in Battery mode returned a running time of just three hours and 14 minutes, almost half that quoted.

Sadly, there are build quality issues with the V330. The screen is a TN technology panel that has obvious backlight shadowing issues, a limited colour gamut and dire viewing angles.

Despite some shortcomings, there are redeeming features. However, you'll need to be handy with a screwdriver, and be prepared for invalidate your warranty. For inside the V330, you'll discover not only an untapped SO-DIMM slot, which enables you to add an extra 16GB of RAM alongside the 4GB of soldered-in memory; but you'll also be able to swap out the hard drive in the SATA slot for an SSD. Better still, you'll also discover an unused PCIe interface slot, where you could fit an NVMe SSD for the ultimate in storage performance. ■

### Verdict

| | |
|---|---|
| Features | ★★★½ |
| Performance | ★★★½ |
| Value | ★★★½ |

**The Lenovo V330 is attractive on paper, less so on close-up. With a few minor tweaks though, it could be great.**

GAMING MONITOR

**AU PRICE TBC (EST. $999) | WWW.VIEWSONIC.COM/AU**

# ViewSonic XG3220

## Big panel, puny pixels.

**Puny pixels are a big deal. The smaller the pixels, the sharper, crisper, and more detailed the display. For smartphones and tablets, pixel density is all the rage – pixel counts offered by such devices are on the up, while the size of individual pixels shrinks ever smaller.**

For the PC – and desktop rigs with large displays – it's more complicated. For starters, achieving so-called "retina"-style pixel density on a monitor measuring, say, 30 inches or more would a require a monumental pixel count, measuring in the high tens of millions. The kind of pixel grid, in other words, that existing display interfaces can't cope with.

Then there's the minor matter of scaling. With a handheld device, the fact that most of the Internet remains built around bitmaps doesn't matter much. On a large display, the fact that few websites have full support for high pixel density, also known as high DPI, displays is more problematical. Meanwhile, the Windows OS's support for multiple DPIs has improved but remains frustratingly short of truly slick.

That's the context for ViewSonic's latest 32-inch monitor, the XG3220. It's one of a number of displays trying to achieve the best possible compromise between pixel density, desktop real estate, and the realities of DPI scaling. As it happens, it pretty much nails it. The combo of a standard UHD grid numbering 3840x2160 pixels with a 32-inch diagonal makes for a reasonably dense grid, and thus fairly sharp fonts. At the same time, the generous proportions allow for plenty of options when it comes to scaling. Users with excellent eyesight could opt for 100 percent scaling, and thus no issues at all with bitmaps and legacy aspects of the Windows interface. Everyone else can go for 125 to 150 percent scaling, and still retain a generous amount of desktop space.

Of course, all of that applies to every 32-inch UHD monitor, so what marks the XG3220 as special? ViewSonic has opted for a VA panel, where most incumbents in this part of the market favor IPS. The upsides include rich colours and excellent static contrast. This LCD screen achieves a 3,000:1 ratio between light and dark, without recourse to active backlighting or local dimming.

The VA panel also contributes to the XG3220's advertised HDR10 compatibility. Which is where the wheels begin to come off. While it does offer wide colour gamut support, including 99 percent of the sRGB color space, that's the limit of the XG3220's "HDR" capabilities. With no local dimming and a peak brightness of 300cd/m2, pitching this as an HDR display is a stretch. It's simply confusing and devalues the notion of HDR.

The other issue related to the VA panel is pixel response. ViewSonic has included a multi-step pixel overdrive option in the menu, but even at its most aggressive setting, ghosting and blurring is very apparent. The panel is also limited to 60Hz refresh, where 120Hz and up is becoming de rigueur for serious gaming screens.

The saving grace is the XG3220's relatively accessible price point. The reality is no single screen can give you everything. You can't have 4K resolution combined with zippy responses and high refresh for around a grand, that's for sure. So, ViewSonic's latest is far from perfect. As a gaming monitor, it's fairly flawed, but if you want alarge and appealing 4K monitor for not much money, you've found it.

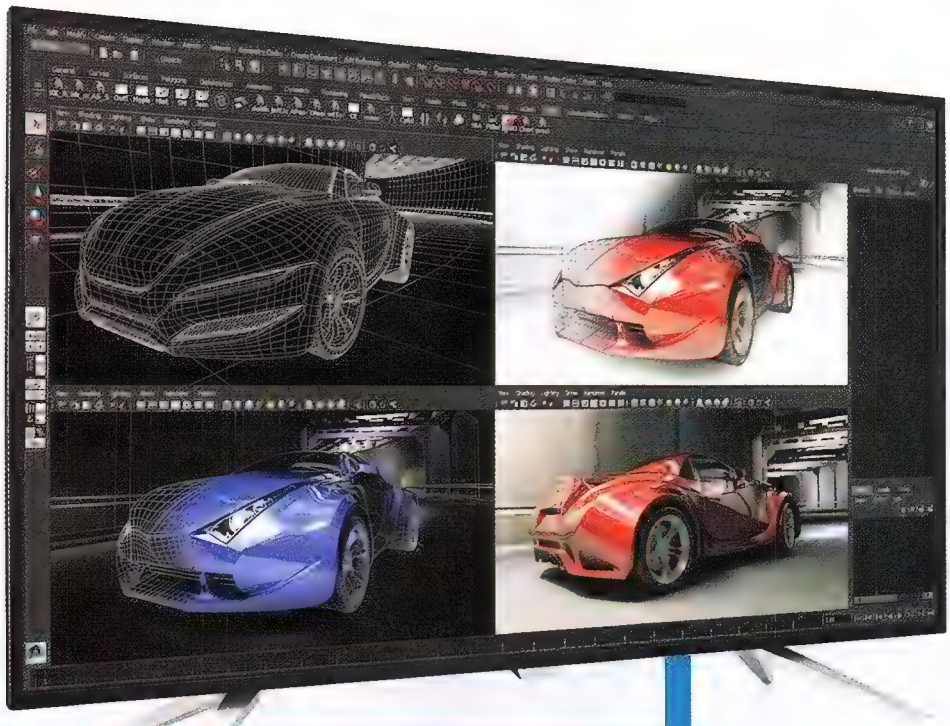
**Jeremy Laird**

### Verdict

| | |
|---|---|
| Features | ★★★★½ |
| Performance | ★★★★ |
| Value | ★★★★½ |

**Dodgy HDR credentials aside, this is a good compromise between panel size and pixel density for a budget screen.**

★★★★½



MONITOR

**$799 | WWW.PHILIPS.COM.AU**

# Philips Brilliance BDM4350UC

## A design that blurs the line between a 4K TV and gaming monitor.

**Now you can call *that* a monitor! This 43-inch monster display aimed at those who aspire to 4K, and want to be able to see the extra details when they run in this mode from across the room.**

But how practical is a screen this big – and what's been sacrificed to hit that sub-$800 price point?

As designs go, the Brilliance BDM4350UC doesn't break any moulds or challenge any expectations. It's a 43-inch IPS panel – with a 1cm border on three sides and a marginally thicker bezel on the bottom – that most people will immediately assume is a TV.

It weighs nearly 10kg, though there are VESA 200 mounting holes for those who like wall mounts or desk pillars.

One annoyance we immediately identified was the placement of the input ports on the rear of this screen. There are five video inputs: two DisplayPort 1.2 connectors, another pair of HDMI 2.0 ports, and a wholly nostalgic VGA port.

Up to four of the inputs can be used at once, should you have four 1080p systems that you'd like to see picture-in-picture.

Along with the video inputs, there are also audio jacks and a full USB 3.0 hub with four ports.

What's wrong with all these inputs is that they are all at 90° to the back of the screen, rather than flush. That means for wall mounting, you will probably need to find cables with L-shaped connectors, or you will have cabling problems. Philips quotes an sRGB gamut of 100 percent for this panel, although in our calibration testing we only managed 97 percent and just 75 percent of Adobe RGB. They're good numbers, but it wouldn't tempt anyone who works professionally with colour – such as designers or photographers – to pick this monitor.

For gaming purposes, the colours are fine if not exceptionally punchy, and the static contrast levels are good – even if they need a little tweaking away from the default settings to get the best from them.

Pleasingly, the tonal response is almost exactly Gamma 2.2 across the full range. But what lets this panel down is the inconsistent backlight. Most screens are brighter in the centre than the edges, but the BDM4350UC's variation is extreme. In testing luminance levels, the middle of the screen was generating 279 cd/m2 whereas the top-right was only 205 cd/m2. That's a third lower.

The other problems are frame and backlight shadows that become very apparent when the screen is a uniform colour. In fast-moving games with a complicated background these artefacts weren't noticeable. But, set the desktop to a single flat colour, and they immediately become apparent.

This may not be the case with the BDM4350UC you purchase, of course, so all we can report is what we saw with our review sample.

There is one more issue: Can you afford 4K?

We'd recommend that the minimum spec for 4K gaming is at least an Nvidia GeForce GTX 1070, but ideally you need a GTX 1080 if you like those detail settings to remain high. If you don't have a fast contemporary GPU, they can be an expensive proposition This screen takes up a lot of real estate: you have either a very deep desk to place it on, or a room where the screen is situated at least 1.5m away from your eyeballs.

Financial and practical factors aside, this is a whole lot monitor for the money, despite its iffy performance. Pair it with a tuner, and you have a TV to boot. ■

### Verdict

| | |
|---|---|
| Features | ★★★½☆ |
| Performance | ★★★☆☆ |
| Value | ★★★★½ |

**A 43-inch 4K monitor that unfortunately suffers from iffy backlighting and other issues.**

★★★½☆

SCREEN

**$269 | AU.AOC.COM**

# AOC I1601FWUX

## Work smarter wherever your laptop goes.

**There's one big problem with carrying a MacBook or ultra thin PC laptop around: the lack of screen space for your windows. Without a generous helping of screen estate, it's just not possible to function quite as efficiently as you might with a desktop arrangement. But AOC's clumsily-named I1601FWUX offers a straightforward path to getting an extra 15.6 inches on the go.**

Presuming you have a Mac or Windows laptop that's USB-C compatible, this screen couldn't be simpler to set up: plug it in using the single cable, and in a few seconds it'll be detected and activated as a second display.

The magnetic cover also acts as the screen's stand, enabling portrait or landscape mode with a reasonable level of adjustability. We wish the magnets were stronger as they're on the weak side.

Hardware-wise, this is a package which bounces from decent to lacking; the panel is 1080p and incredibly sharp with it, with an excellent range of viewing angles, but it can be a little dim at times.

It'll get the job done for on-the-road work with documents and content, but you won't eagerly pull this out of your laptop bag unless you need the extra screen. When we viewed the trailer for *Avengers: Infinity War*, the colours of costumes and explosions were a bit muddied, and dark elements, like the details on Black Panther's suit, were difficult to see.

The best thing the AOC I1601FWUX has going for it is its brightness, which measures 212.6 nits. That's brighter than the similar ASUS ZenScreen MB16AC (179.6 nits), the AOC e1659fwu USB Monitor (177 nits) and the USB 3.0-connected Asus MB168B+ (163 nits), but even most cheap desktop monitors offer better brightness.

However, the colour gamut was less impressive, as the AOC monitor reproduced just 62% of the sRGB colour spectrum. The ASUS ZenScreen MB16AC had a better score of 72.4%, but 100% or better is the ideal. There's around a 5ms response time, which is barely noticeable, but the panel often tended towards the smeary under our suite of moving-image tests.

The screen is thin and light, which is great for portability, and the cover stayed put when we carried it in a rucksack, but we're not 100% convinced on it being able to remain attached at all times given its rather tenuous ability to support the screen as a stand.

The entire thing measures 37.8 x 23.5 x 0.76cm and weighs 820 grams (1kg with the included cover), which makes it slimmer and lighter than most tablets and significantly lighter than most ultraportable laptops. Although it's slightly larger than the ASUS ZenScreen MB16AC (37.1. x 22.6 x 0.8cm, 1.27kg with cover), it's lighter and still small enough to easily slip into a laptop bag.

If you're not planning to use this away from your desk, the asking price is higher than that of some larger, higher resolution screens. But what price flexibility? The screen's immediacy is very difficult to argue with; while it may not be the best display around, it's very good compared to the competition and if you're after a portable screen, it's a great choice.

The data rate of its one-cable connection means it comfortably handles 60Hz signals, and unless you're really pushing the action you won't be disappointed with the results.

**Alex Cox**

### Verdict

| | |
|---|---|
| Features | ★★★★ |
| Performance | ★★★½ |
| Value | ★★★½ |

**It's not the best display around, but it's certainly one of the most compelling portable USB options.**

★★★½

apc HOT PRODUCT

"The drive is more than just an external SSD: it offers the travelling photographer a way to back up images from an SD card directly to the drive with a single tap."

PORTABLE SSD

**FROM $429 (250GB) TO $1,399 (2TB) | WWW.WDC.COM**

# WD My Passport Wireless SSD

## A must-have tool in every travelling photographer's bag.

**Storage giant Western Digital is no stranger when it comes to creating gear that serves the needs of pro photographers. Over the last few years, it's focused on this segment with a range of devices that makes transferring and backing up photos while in the field quicker and simpler – chief among them its two Wi-Fi hard drives. The company has now added a third with this new SSD model, with the main draw being the additional speed and durability that solid-state storage provides.**

Like its hard drive-equipped siblings, the My Passport Wireless SSD has been built for life on the go: it comes packing a built-in SD card reader, 802.11ac Wi-Fi connectivity and a built-in battery that gives you up to 10 hours of use. Once you've got the images from your camera's SD card transferred, you can view them on your smartphone or tablet via a the My Cloud app without needing to go near a computer. While the device isn't weather- or dust-proof, it does come in a removable drop-resistant bumper, giving it a rugged look and a non-slip surface. Moreover, all the ports and buttons are flush with the exterior, and in combination with the thickness of the bumper, that should help protect them.

Setting up the Wireless SSD is a breeze – just connect via Wi-Fi using the details that are printed on a sticker on the drive's top, then log in via a web browser or the WD My Cloud app. On both, the user interface is straightforward, and although the drive is already configured for immediate use, there's a range of optional advanced features you can take advantage of. For example, users wishing to stream media (up to 4K resolution) directly from the drive can install the Plex Media Server and watch movies on their smartphones or tablets without consuming their precious onboard storage space.

While the older hard-drive models in Western Digital's wireless range are decent performers, the SSD version leaves them for dead, with roughly triple the speed increase when transferring files to and from a PC or Mac via USB. In our tests, we clocked a top read speed of 390.1MB/s and 385.5MB/s for writes. While that doesn't make this the fastest portable SSD money can buy – we've had USB SSDs hit 500MB/s – it's a big boost over the 130MB/s you'll see from the fastest conventional hard drives.

But the drive is more than just an external SSD: it offers the travelling photographer a way to back up images from an SD card directly to the drive with a single tap. Simply insert the card into the slot, press the transfer button and *voila!* It's that simple. It can even transfer files from other USB flash drives as well, and can charge your devices via its USB On-the-Go port that supplies up to 1.5A of power.

It is disappointing to see only a non-standard 10-pin micro-B USB 3.0 port on the drive for connecting to PC – a USB-C port would have been preferred – and means you're stuck using the included 'USB micro-B to USB-A' cable for PC transfers. That makes connecting to newer laptops with only USB-C a pain. Plus, that On-the-Go port is USB 2.0 only, meaning transfers from external USB 3 devices will often be severely throttled.

If you can live with those caveats, and need the extra robustness and speed that solid-state storage offers, however, this one's a great alternative to WD's existing wireless hard drives.

**Sharmishta Sarkar**

### Verdict

| | |
|---|---|
| Features | ★★★★½ |
| Performance | ★★★★½ |
| Value | ★★★½ |

For those that need the extra speed, this is a solid addition to WD's already great wireless drive line-up.

★★★★½

KEYBOARD

$339.95 | WWW.ROCCAT.ORG

# Roccat Vulcan 120

## A second look at mechanical keyboard design.

**Mechanical keyboards laden with Cherry switches provide those who invest in the pricey products with a feeling unlike any that a membrane or chiclet keyboard could produce. The responsiveness and the immediate and tactile nature exuded by those switches is second to none. Once you're adjusted to the noise they make there's no going back.**

Since the start of this trend, we've seen plenty of refinements. So where do you go from here? How do you stand out in such a crowded market? Roccat believes it may have the answer.

Known for its budget-oriented headsets, mice and keyboards, Roccat's not typically at the premium frontier of PC gaming peripherals. The Vulcan 120 stands in stark contrast to the German company's traditional offerings. It's clean, sophisticated, and markedly elegant. The single sheet of brushed aluminium is simple and smooth, unblemished by any obtrusive gaming insignias or branding. The key switches, a custom built mechanical variant, are raised, transparent and fully lit with the now industry standard array of RGB LEDs, and although not from Cherry, they're some of the better bespoke switches we've seen.

Roccat's Titan Tactile switches are smooth and responsive under touch, like some strange amalgamation of a Cherry MX Red and an MX Blue, all mixed in with a super-low actuation point (1.8mm versus 2mm). They're an absolute joy to type on, every keypress cementing itself down into place firmly, with only the faintest of clicks behind it. It's a subtle feeling – very subtle – yet still strong enough to let you know it's there.

It's quiet, too. Well, quiet for a mechanical keyboard, at least – no louder than that gaming staple, the MX Red, that's for sure. But it's that immediacy and feel that we like the most, especially in game. This is all thanks to how the key switch works in conjunction with the key cap itself.

In short, this is all down to just how small these key caps are. At their thinnest, each of the Vulcan's caps are just over 3mm thick, and at the fattest part of the cap they're 6mm. Compare that to a standard cap found on a Corsair K70 – 7mm and 10mm, respectively – and that's a lot less overall plastic involved, which in turn means lighter caps.

It doesn't sound like much, but reducing the overall weight in the cap means you have to apply slightly more pressure on each key to activate the switch (we're talking minuscule amounts in reality).

For absolute immediacy, you're still going to want a linear switch (an MX Red, for example), but for those who are keen typists, or who don't rely on split-second response times, this makes a big difference. Each click is more forceful, and it sounds and feels better. The thicker caps suddenly feel dampened, there's less tactile feedback from them, and the sound is almost muffled in comparison. This makes a remarkable difference in the overall feel of the Vulcan.

Ultimately, Roccat's Vulcan 120 is a strong addition to Roccat's lineup. Its uncompromising use of build materials, utilised alongside the brilliance of those key switches, makes it a keyboard to look out for, and a definite contender for anyone looking to invest in a serious piece of premium finger-punching luxury. As far as switches go, Roccat's Titan Tactile is one of the best out there right now. The only real shortcoming? That Australian RRP is ludicrous. ■ **Zak Storey**

### Verdict

| | |
|---|---|
| Features | ★★★★½ |
| Performance | ★★★★½ |
| Value | ★★½ |

Deftly combines phenomenal switches, clean aluminium design, good key caps and solid software. But that price...

★★★★☆

GAMEPAD

$65 | AU.MSI.COM

# MSI Force GC30

## Versatility is the key to a good controller.

**There are games out there that don't fit so well with the PC staple of a mouse and keyboard environment.**

Sure, a good tab-targeting MMO can take advantage of all those extra buttons, but if you're on a budget, and can't afford that full-sized racing cockpit, trying to get your brain around using digital key switches to pilot your decidedly non-digital motorized vehicle of choice quite simply sucks. While you can opt for an old-school Xbox 360 USB controller for a little under $30, it's outdated and definitely not wireless. SteelSeries, Razer, and Logitech all offer their own expensive variants.

Enter MSI's Force GC30 – and their first foray into peripherals hasn't been a bad run at all.

The abundance of connectivity will catch your attention. By default, it comes with a 2m long cable to connect it to your rig via USB, and a 12-inch micro-USB cable for your mobile devices. Then there's the 2.4GHz wireless dongle, which means you can also connect wirelessly to your PC or any PS3.

On top of that, it's also got a built-in battery, dual vibration motors for haptic feedback, and an Xbox-like controller layout. It even has replaceable D-pad covers if you're not happy with the overall feel of the standard cross style.

As for downsides, the overall material used could be a little more premium, and it is a touch small, but apart from that, there's little to complain about. All in all, it's comfortable, has a whole plethora of connectivity, brings a chunky battery to the game, and comes in at a fairly aggressive price.

■ Zak Storey

### Verdict

Versatile connectivity; comfortable grip; replaceable D-pad; good battery life; excellent price.

★★★★½

GRAPHICS TABLET

$1,399 | BUYWACOM.COM.AU

# Wacom Cintiq Pro 13

## A pro-level graphics tablet at an entry-level price.

**Straight out of the box, the display on the Cintiq Pro 13 is striking, attractive, and well-balanced, making it comfortable to hold. Professional designers or those who dabble in digital art should take note, albeit for different reasons.**

The top right side of the 13.3-inch 1080p display features a set of minimal touch controls and there are three USB-C ports on the sides (one left and two right), and the back features a nifty 20° pop-out stand for desktop work. And then, inevitably, you need to chain it to your desk with various cables. Depending on the setup, that means you could be forced to work with a power cable plus signal-out to Wacom Link Adapter, then USB and Lightning cable snaking to your machine. That nest of cables isn't ideal and frankly feels entangling.

In fairness though, it does become bearable once you start to work with it. After getting the 13 Pro set up as a second display to our Mac, we instantly created workflow efficiencies, be it shifting reference material onto the smaller screen to avoid app switching, to diving into photo retouching and digital art with the fantastic 8,192 level pressure-sensitive pen. After moving, twisting and zooming pics around the Cintiq Pro's screen using multi-touch, it became so natural that it felt odd shifting back to a mouse for digital art.

Now, we know we're really comparing two types of fruit here, but if you need a heavy-lifting design machine to back creative tasks, the Cintiq Pro 13 aptly serves as a great workflow tool. However, if you're more after a simple tablet for drawing or digital art, the iPad Pro might be a better (and more flexible) alternative. ■ Troy Coleman

### Verdict

A high-end graphics tablet and second display at a very desirable price. Great at what it does.

★★★★½

# software

» APPS FOR ALL THE PLATFORMS

## Windows SOFTWARE

# Stellar Phoenix Windows Data Recovery

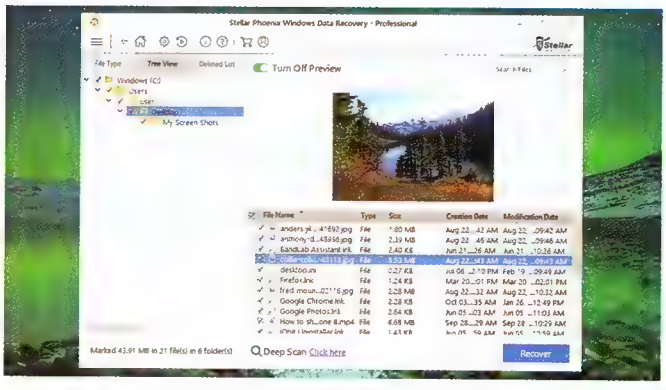
### Truly stellar data recovery software.

**FREE VERSION AVAILABLE (WITH SOME LIMITATIONS); PRO, US$69.99**
**WWW.STELLARINFO.COM**

**Stellar Phoenix is one of the biggest names in data recovery, and when you take Windows Data Recovery for a spin, you soon see why. First of all, it's flexible. Stellar Phoenix Windows Data Recovery offers a choice of quick options at the outset. You can perform a general search for any kind of deleted file, or narrow the field to Microsoft Office documents (including Word, Excel and PowerPoint files), emails, photos, audio and videos. If you've lost an entire folder, you can also attempt to retrieve that.**

An advanced settings option offers the ability to preview files during scans, and while this does impinge on speed, it can be extremely helpful if you're looking for a specific file (like say, an image), since it'll save you from having to recover an entire folder. And if you stop a scan prematurely, that's not an issue – Stellar Phoenix logs incomplete scans, so you can resume them later.

Now, often if you've lost a specific file, you'll know exactly what it was called and what the extension is. Delving into those advanced settings again lets you specify a certain file type to scan for. There are scores of options, helpfully divided into different categories including media, documents, text and archive formats.




You can also recover a lost partition – a feature you rarely see in free recovery software – or recover data from a disk image. If you don't find what you want immediately, there's also the option of performing a deep scan, which will take longer but will turn up many more results.

The only real drawback is that the pro version of Stellar Phoenix costs considerably more than rivals like Recuva Pro and DMDE Standard, but it could be well worth the expense if other free tools fail to turn up the goods.

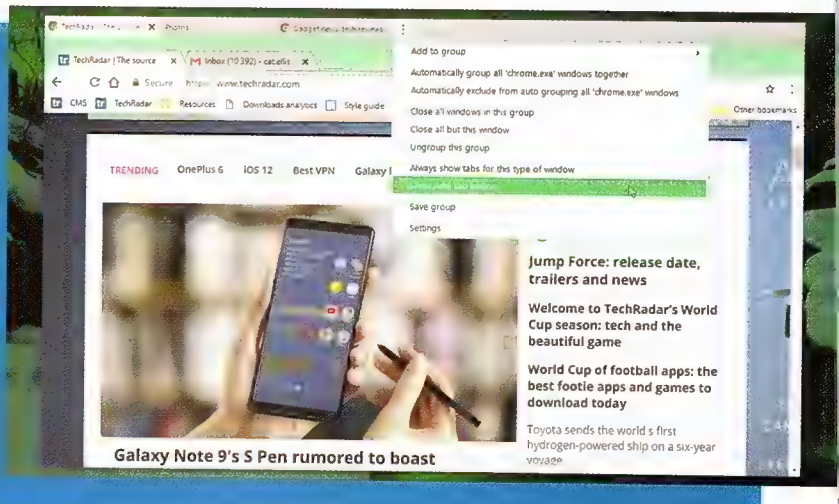
If you're not sure whether to invest in Stellar Phoenix Windows Data Recovery, the free trial lets you see which files and folders the full software would be able to recover for you, so you can compare it with the results from cheaper or free data recovery software. **Cat Ellis**

## Groupy

### Keep tabs on your programs.

**US$9.99 | WWW.STARDOCK.COM**

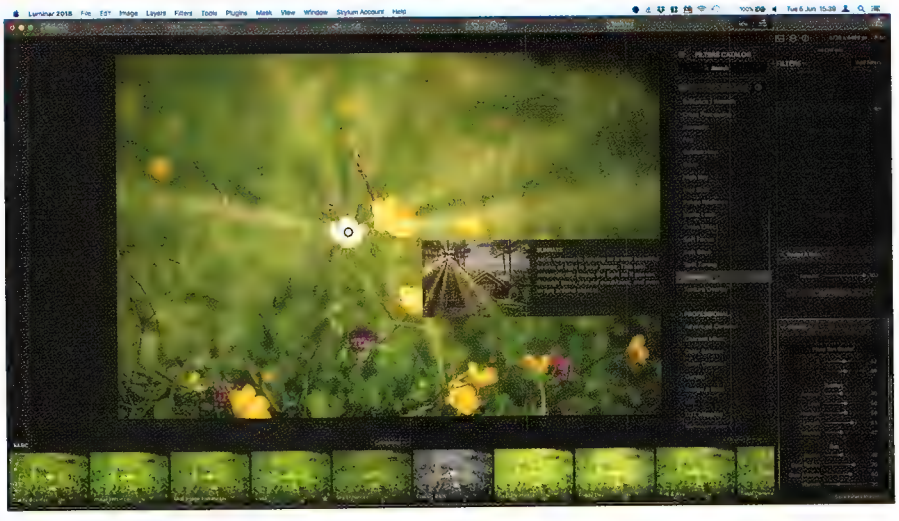
Much like Microsoft's Sets feature on Windows 10, the Groupy software from Stardock Software lets you organise your PC programs in browser-style tabs. That might sound like a recipe for chaos when you have multiple browser windows and documents open at once, but (as its name suggests), Groupy lets you gather related tabs together in curated collections. To start creating a set of tabs, simply open two windows, grab one and drag it over the title bar of the other. Rearranging tabs is a similar drag-and-drop affair, where you create a group of tabs by placing one tab directly atop another. If you find yourself grouping tabs together accidentally when trying to move them, you can also assign a conditional grouping key. Stardock Software offers a 30-day free trial of Groupy, after which you can decide whether it's worth the investment. (If the answer to that turns out to be 'yes', then you can save a further 50% off with the voucher code RADARGROUPY, courtesy of our sister website TechRadar.) ■ Cat Ellis


Add to group
Automatically group all 'chrome.exe' windows together
Automatically exclude from auto grouping all 'chrome.exe' windows
Close all windows in this group
Close all but this window
Ungroup this group
Always show tabs for this type of window
Save group
Settings
TRENDING
OnePlus 6
iOS 12
Best VPN
Jump Force: release date, trailers and news
Welcome to TechRadar's World Cup season: tech and the beautiful game
World Cup of football apps: the best footie apps and games to download today
Toyota sends the world's first hydrogen-powered ship on a six-year voyage
Galaxy Note 9's S Pen rumored to boast

# Luminar 2018

## This image editing app gives Photoshop a run for its money.

**$99 | SKYLUM.COM/LUMINAR**



**Skylum, which was formerly known as Macphun, likes to take a different approach to photo editing. Its Luminar app is often compared to Lightroom, but it doesn't have the asset management abilities of Adobe's software; Skylum is working on this, however.**

Luminar is a non-destructive editor – your original image file isn't changed by the edits you make, and instead they're only applied when you export your edited photo as a new file. Effects are added as filters, which can be faded out, layered on top of one another or applied selectively. There are cropping and rotation tools, along with Lightroom-like sliders to alter exposure, contrast, saturation and the like.

New features in this 2018 release include lens correction tools to even out the distortions introduced by camera lenses, particularly wide-angle ones, plus increased speed in the raw file handling and noise reduction systems. The updates make the app more attractive if you use interchangeable lens cameras, since it can correct for every quirk and fly through the processing of large raw files. Raw processing depends as much on your Mac's Intel processor as the software you're using, of course, but every speed improvement helps.

Luminar separates its one-click edits into presets and filters. The presets live in a bar along the bottom of the interface, while filters have their own section in the editing sliders on the right. New filters in the 2018 edition include Sunrays, which sends beams of light from a user-defined centre, and Dodge and Burn, which lets you paint areas of darker or lighter tones directly onto your image. Luminar's way of working can take a while to get a handle on, especially if you're used to Adobe products, but it's a well thought-out process married to an interface that's maturing nicely. It has its quirks, such as the buttons spread thinly across the top and filters that are applied at 0%, so you wonder what they do, but with Luminar 2018, Skylum proves it's a real force in the software world.

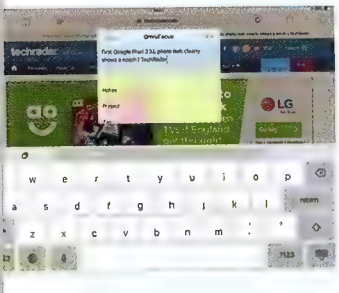
With no subscription and a price lower than that of Photoshop Elements, aspiring photographers should turn their lenses on Luminar. It's a fully featured image editor, with more functionality being worked on.

**Ian Evenden**

# OmniFocus 3

## A flexible, powerful task manager.

**FROM US$39.99 | OMNIGROUP.COM**



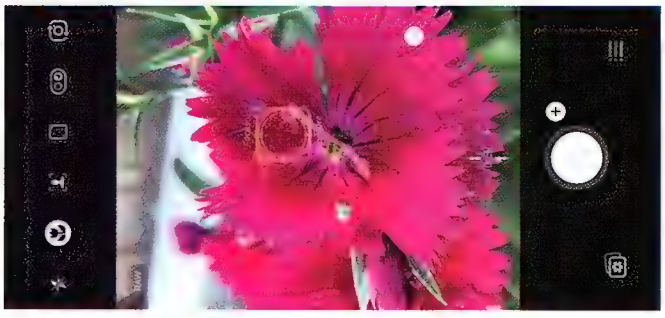
OmniFocus is easily one of the more expensive taskmaster iOS apps. Is it worth it? The app's power lies in the way it slices and dices your data. Tasks can be tagged, put into projects and given due dates. You can mark which tools they'll require, where they should be performed, and even how motivated you need to be to tackle them.

The more of this metadata you add, the better OmniFocus performs. So when we found ourselves with 15 minutes to spare, we filtered out any longer jobs and those for which we didn't have the necessary tools to hand. If we were by the phone, we could switch to our tagged calls; when online, our emails. OmniFocus helps us fill the otherwise wasted pockets of our workday — and you don't need to fill many to start recouping the cost — particularly if you work for yourself.

Your tasks feed into a home screen with four key views: projects, tags, flagged jobs and anything that needs to be done close to your current location. These are 'Perspectives', the name that's given to the app's sorting and filtering features. You can build your own by combining tags, durations, dates and so on, and save them for easy access, but this can only be done if you're using the Pro edition. Pro also lets you customise the sidebar, but otherwise its feature set mirrors the Standard build.

Whichever version you go for, your data is synced between your iOS devices, but syncing with a Mac requires a separate purchase. Version 3 for macOS is in the works, but buy version 2 today and you'll get a free upgrade when it's released. In the meantime, Standard for Mac tips the scales at US$39.99, and upgrading to Pro costs US$79.99. A 14-day trial of the iOS edition is available from the App Store; a 14-day trial of the Mac edition is available from the developer site.

OmniFocus makes it really easy to keep your life in order. Entering tasks is simple and filtering them is a breeze. Used in the right way, it can make you more productive. ■ **Nik Rawlinson**



# Camera+ 2

## Take your iPhonography to the next level.

**$4.49 | CAMERA.PLUS**

**After eight years and 14 million downloads, Camera+ has been given an overhaul. While Camera+ 2 holds on to the basic character of its predecessor, there's a marked difference in speed and functionality.**

Firstly, Camera+ 2 is now universal. There used to be a different version of Camera+ for the iPhone and the iPad, but now it's the one app that works in identical manner across both devices. Secondly, the new version comes with a lot more manual controls which appear when you bring up the focus and exposure points. You can even enable them permanently in 'Settings > Advanced Controls > Always Show'. With manual controls quite literally at your fingertips, the serious photographer will be glad to know there's RAW support available on Camera+ 2. The output is the best quality image possible, with plenty of information stored so that editing is a lot more precise.

Portrait mode on Camera+ 2 comes with Depth Editing functionality, which saves the depth map with the image, so you can edit either just the foreground or the background. However, we found Portrait Mode on Camera+ 2 to be shaky and produced inconsistent results. Editing images taken using the portrait mode on the iPhone's native camera app is the better option.

Camera+2 goes beyond Macro and Portraits modes, though. There's a slow shutter mode for those who like taking long exposures of up to 30 seconds, with the app automatically adjusting sensitivity to compensate. There's also a smile mode which does well to pick up a cheeky grin, even on the front-facing camera. The best part for us, however, is the Stabilizer mode, which removes blur if you have shaky hands. The original Camera+ was tedious to use as an editor because you needed to manually import images from your Photo Library. Now, though, you can switch between the Lightbox and your Photo Library with just a few taps.

While some may argue that 'overhaul' might not be the right word for an app that pretty much looks the same as its predecessor, we think the Camera+ 2's speed and increased functionality makes it well worth the money, given it's been future-proofed for newer versions of iOS and iPhones. Plus all the editing tools, including filters, are now available up front, with no more in-app purchases hidden away. **Sharmishta Sakar**

# Mapstr

## Create a map of the world you want.

**FREE | WWW.MAPSTR.COM**

While Google and Apple Maps are enough to get around, they don't cater to you specifically. So why not build a map that lists the places you love, or want to visit, with your choice of tags? And while you're at it, why not share that map with your friends? Mapstr gives you a map of the world that you populate with places you know, love or want to visit. There's a search bar which is surprisingly quick; you then add the place you want, creating a new tag for it (such as, Photography) if desired. Once saved, Mapstr will add any additional info available, like opening hours and contact details, so you can plan a trip. You can even add your own notes for each place and Mapstr will connect you with modes of transport to the location if its available. In case a place you want saved has no name, Mapstr lets you create one. It's your personal map, with places from anywhere in the world marked on it. If you already have a list of places geotagged elsewhere, like on Facebook or Instagram, you can import a KML or CSV file and Mapstr converts the information. It's easy to use and even works offline. **Sharmishta Sarkar**

# Tweetbot 4

## Twitter made fitter.

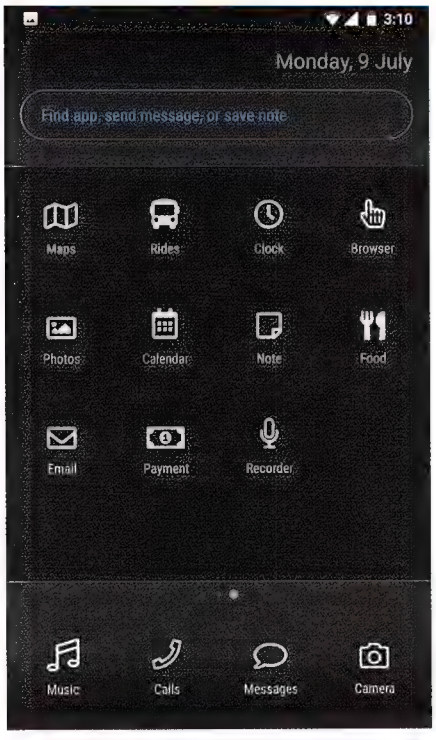
**$7.99 | TAPBOTS.COM/TWEETBOT**

With over 330 million users, Twitter tends to move fast — too fast, potentially, for the syrupy official app. That's where Tweetbot comes in. It's quick to update, quick to scroll through your feed, and eschews those little extras (or annoyances) that Twitter sees fit to provide as part of the mainline app. There's no 'you might have missed' — you're thrown straight into the action. Jumping into threaded conversations is as simple as a swipe, and there are stacks of shortcuts for common interactions, accessed with swipes or by long-pressing the buttons on the bottom menu.

Tweetbot offers several interface niceties, too: swipe two fingers down (or set it to trigger at a certain time) and you can activate a comfortable night mode; flip a larger-screened device on its side, and (as of Version 4) you'll get a column view with your replies, custom lists, or searches. This fourth iteration also adds a brilliant activity view, which combines all of your notifications into a glanceable list, and a real-time statistics view which shows you how much traction your tweets and account are getting.

This is far from an essential app when there's such a solid free, official option on offer. But Tweetbot is less bloated, and for those little tweaks and extras, for a clean, clear, customisable interface, and for the convenience of Tapbot's flawless multi-device synchronisation, the small investment could well be worth it.

This app is responsive and beautifully designed... and just a little unnecessary. ■ **Alex Cox**




# Siempo

## Cleverly dumb down your smartphone.

**FREE (WHILE IN BETA) | GETSIEMPO.COM**

**Regardless of the alleged purpose, most major time-sinks you'll find on your phone are deliberately keeping you hooked in order to serve you with more advertisements and fund their service. There are a number of psychological tactics being employed to keep us captive and compulsively checking, but Siempo aims to undo some of this by turning your handset back into a device of utility.**

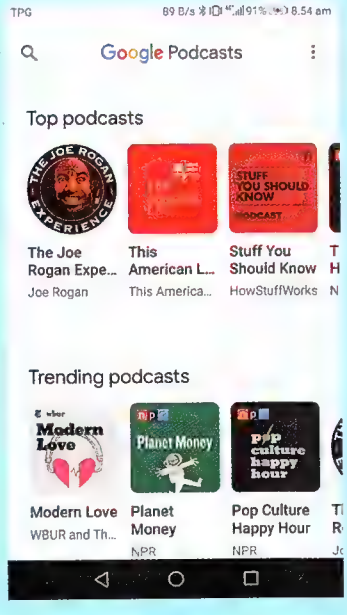
Siempo is a launcher, removing distractions from your phone's interface without altering the apps themselves. The result is vastly stripped back, near-monochromatic colour scheme (switchable from a light to a dark theme), and uninteresting app icons. You're able to type in "your intention", so that each time you unlock your phone, you're met with a suggestion of a better way to spend your time, or you can alternatively leave the main screen blank. The remaining three screens are reserved for your apps and are categorised into tools, frequently used, and flagged. Siempo will gently nudge you to stop if you've been using any of your flagged apps for too long. You can choose which apps to flag, although Siempo already has a pretty good idea of the culprits and automatically flags the likes of YouTube, Facebook and Instagram. Siempo also incorporates a function referred to as Tempo, which allows you to batch all incoming notifications at a time or interval of your choosing. **Harry Domanski**

## Google Podcasts

An official Google app that offers little more than what its name suggests.

**FREE | TINYURL.COM/APC458-GOOGLEPOD**

It's not like anyone is struggling to access podcasts these days, what with all the great free and premium delivery apps out there: Pocket Casts and TuneIn Radio, to name a few. But here's a new one anyway, bearing the clout of an official Google app. The fact that Google Podcasts is buttery smooth, with virtually no load times, is probably the best thing going for it. Otherwise, it's as stripped back and 'functional' as a podcasts app can be: the front page shows eight categories, ranging Arts through to Sports, News through to Comedy. If you're not a fan of these eight categories, it's bad luck: there ain't any more. There is a search function, but this only searches the title of existing podcasts, so you have to know what you're looking for. All in all, if you're the type who listens to a small handful of well-known series' this will suffice. If you like to browse and sample, Google Podcasts doesn't do much to facilitate curious minds. **Shaun Prescott**

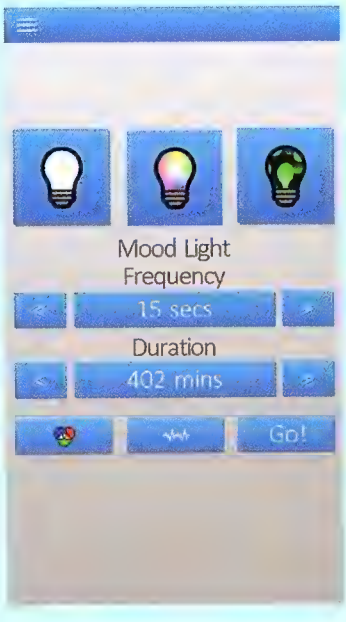



## Best Night Light

A sleeper hit.

**FREE WITH IAP | WWW.WARRIORSOFTHECUCUMBER.COM**

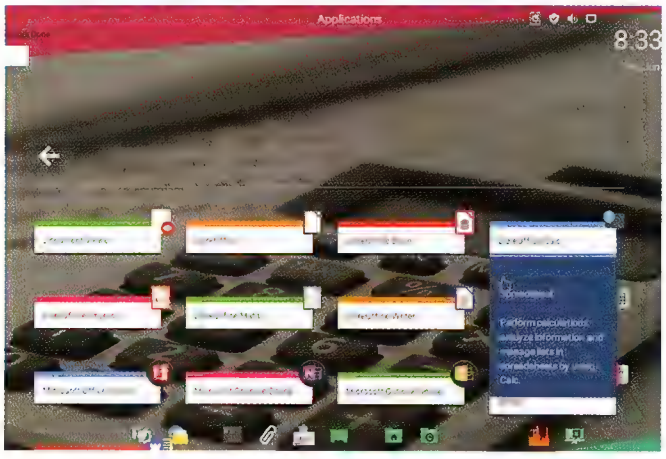
Best Night Light turns your smartphone into an all-purpose light designed for use at night, whether you need something to gently illuminate your way to the bathroom, or a gentle light show to help send you off to sleep. It comes with three modes — the night light, which you use instead of a torch, Mood Light and Lava Lamp. The latter two rotate through the colour spectrum and also create something that looks like a Winamp graphic equaliser setting, respectively. The app is streamlined, and the UI is thankfully clutter-free — it does feel pretty budget, but since you're not really looking at the app, per se, it's not going to put you off. The point is to create ambience, so we found the best way was to position our phone near a white or light-coloured wall to give the patterns a good canvas to reflect off. You can also turn on some background sounds — rainfall, waves and so on — if white noise helps you drift off. **Paul Taylor**



# Jade

## A brightly coloured Linux desktop environment.

**FREE | GITHUB.COM/CODESARDINE/JADESKTOP**




**We love bringing innovative and ground-breaking Linux desktop environments to your attention. When Jade popped on to our radar, we were interested to see if it looked and felt different from Gnome, KDE or any other 'lighter' desktop.**

Jade is a HTML5, CSS and Python-based desktop that has its own layout, menu system and some cool extras, such as speaking menus and titles, as well as a customised selection of some more traditional GTK3 and Qt5 programs.

The placement of its desktop widgets and indicators is certainly original, although, in most cases, you can't rearrange them. The top-centre Applications button activates the grid view of available applications, which are grouped into categories. We tested Jade using the Manjaro WebDad spin and, therefore, some programs may be specific to the distribution, but there are links to the web versions of the Microsoft Office programs and Skype, the V4L testing utility for webcams, the Kvantum-style themer and some other compact utilities.

The bottom part of the screen hosts the dock-like panel with programs, folders and indicators. Some items are groups that expand as stacks with a jaunty curve effect, much like Apple's stack folders.

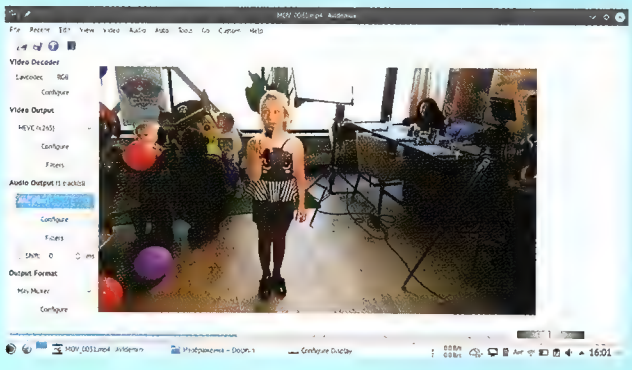
The overall experience in Jade is a little controversial, but it's definitely a fresh approach for interacting with files and programs. Very few desktop components can be changed, so you should accept it 'as is'. For some users the suggested design will be a hit and a perfect match to their desired dream desktop, where every little thing is placed precisely where it should be. The desktop works speedily once you have accelerated video in place.

If you run it on something like Llvmpipe, you'll most likely be frustrated. That's why we strongly recommend running Jade natively, perhaps from a live USB media, and not in a virtual machine. **Alexander Tolstoy**

# Avidemux

## A video editor getting the finishing touches.

**FREE | GITHUB.COM/MEANOO/AVIDEMUX2**




This isn't the first time we've written about tools for re-encoding video files in Linux, although the last time was quite a while ago. Here, we're shedding some light on Avidemux, an interesting video tool in active development. Many people consider Avidemux to be a video editor, and certainly when it's compared with Kdenlive or OpenShot the program looks rather weak. However, if you take the view that Avidemux is more of a video transcoder with some video-editing features, then it works really well.

The purpose of such software is to take a video file and convert it so that the file can viewed on a different device, such as an iPod or a PSP. Furthermore, the video may occupy too much disk space and you can reduce its file size without too many compromises in quality.

The most evident and straightforward approach to Avidemux is to open a video file, select your required output options for video and audio and then save it. Hitting the Configure button for video output brings you into the world of media containers, codecs and their options. You can play around with the program's almost endless parameters for refining, smoothing and enhancing your video, and the process is very self-educative as well.

Apart from video encoder options, there's a nice selection of video filters available in Avidemux. Most of them help remove interlacing and fix colours, but you can also add subtitles or superimpose a logo above the main picture and carry out certain creative tasks.

So while Avidemux can't compete with heavyweight video editors, it certainly beats many media transcoders thanks to the bulk of its more useful video-editing features. Avidemux is powerful and compact, although its many settings and options will take some time getting used to. **Alexander Tolstoy**

# BACK UP NOW TO AVOID CATASTROPHE

**DON'T WAIT UNTIL IT'S TOO LATE! GET YOUR BACKUP SITUATION SORTED WITH OUR COMPLETE GUIDE FOR WINDOWS & MAC: WE'VE MADE IT EASY!**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### CREATE PERFECT WINDOWS BACKUPS
In a world ruled by the God of Clouds, surely backing up your system should be easy? Good thing that it is!

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How to back up all of your important data and restore it when you need to.

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### TERABYTE SHOWDOWN
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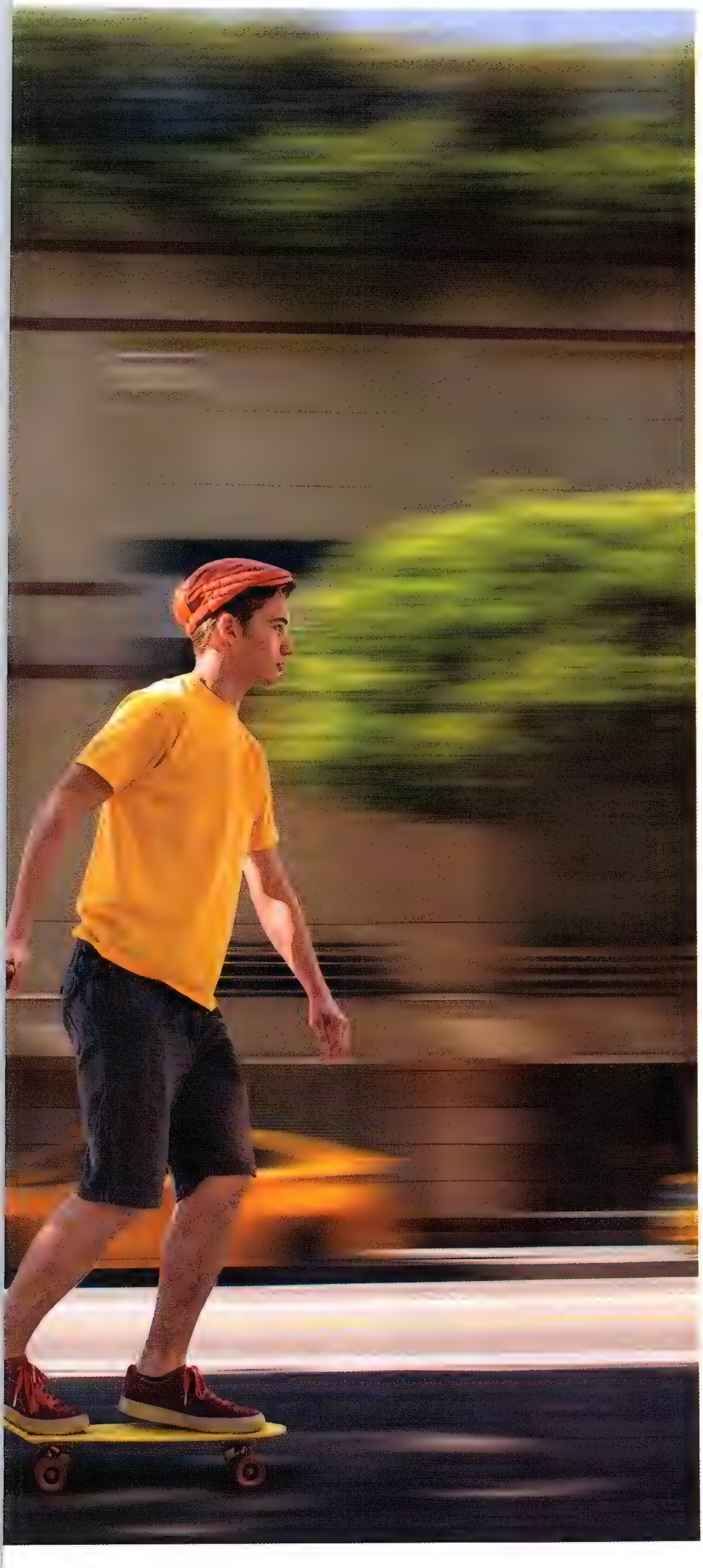
### EXTERNAL SSDs PUT TO THE TEST
Portable SSDs have become faster and more affordable over the past couple of years, but are they still too flashy for your average consumer?

"Part of the problem is that there's no immediate pay-off for using your valuable time to set up a backup regime. It's like dealing with climate change, the national debt or car insurance: It's someone else's problem, isn't it?"



# Create perfect Windows backups

## In a world ruled by the God of Clouds, surely backing up your system should be easy? Neil Mohr is here to show you that it is.

**Backing up is the single most boring subject on the face of the planet; think watching paint dry crossed with 24 hours of Canadian curling in slow motion. Keep reading, though, because it's also quite possibly the single most important task you can do on your PC.**

So how can we make backing up sexy for the Millennials? The usual answer would be to add a little gamification, but as we're not app writers, that's not going to happen. Our next best answer is to make it easy, quick, and as close to being invisible as possible.

Part of the problem is that there's no immediate pay-off for using your valuable time to set up a backup regime. It's like dealing with climate change, the national debt or car insurance: It's someone else's problem, isn't it? Until you total your automobile, or China wants its yuan back, or you're up to your ankles in flood water, or are having trouble finding somewhere to go skiing.

With a tiny bit of planning, backups can be made super-easy today. High-speed wireless, abundant storage, and access to free cloud storage options ensure you're able to back up your data in smart ways that protect your vital personal finances, documents, photos, and whatever else you'd like.

So take 15 minutes out of your day and see how easy it can be. We'll offer up solutions from Microsoft, the best open-source options, and expand our search to full-system images, along with wider cloud options that can help you back up all types of media, often for free, and usually with little work involved.

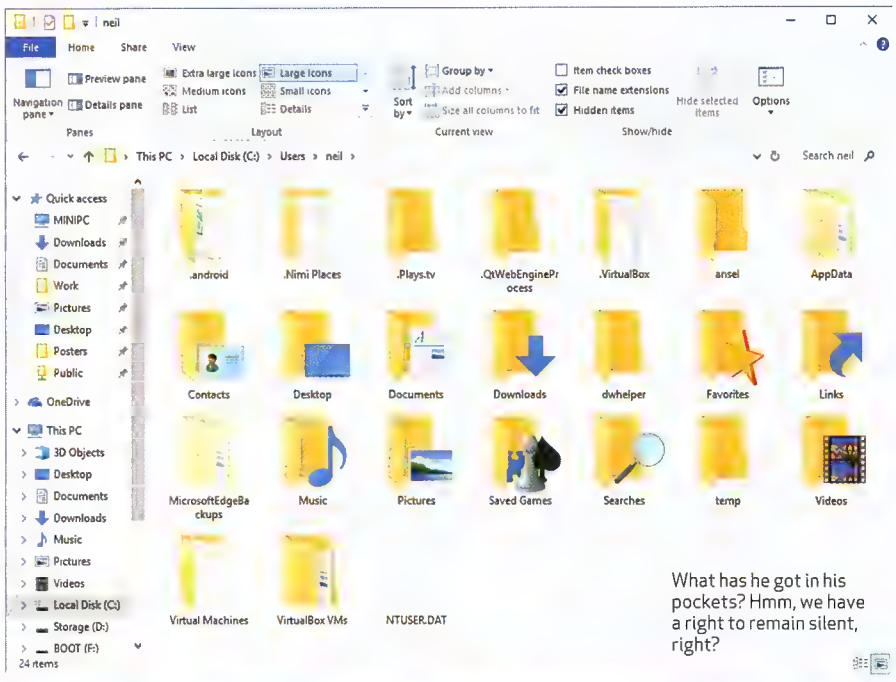
What is best in life? Obviously to crush your enemies, see them driven before you, and to hear the lamentations of their women. That's nice and all, but Conan never experienced the sweet, sweet feeling of restoring a lost file from a well-planned backup. There's a key adjective in there: *planned*. If you want to do backup well, it's best to plan a little, and there are two main areas you need to concentrate on: the source and the destination.

Let's start with the source. What on your computer is important to you? If your PC spontaneously combusted and melted into a pool of expensive steel and plastic, which files on there would be irreplaceable? You should probably plan to have these backed up. There are two main approaches: a brute-force entire-drive system image, or a more nuanced selective backup.

We're going to steer you away from system imaging, though we'll cover it later for completeness. The way we use operating systems, alongside changes in technology, have made system images less useful for personal backup. It's partly to do with deciding what is essential to back up. System software isn't essential, because it can be replaced. General software, too. Your Steam collection doesn't count either, because it can be downloaded again. See how it works?

Photos of your newborn child, your financial documents, that video of Zak taking a tumble off his mountain bike, and anything you'd classify as 'work' will likely be on your hit list of irreplaceable files.

Before you can back these up in any sensible way, though, you need to know where they're all stored. That's why, way back, Microsoft introduced the (My) Documents folder to store




What has he got in his pockets? Hmm, we have a right to remain silent, right?

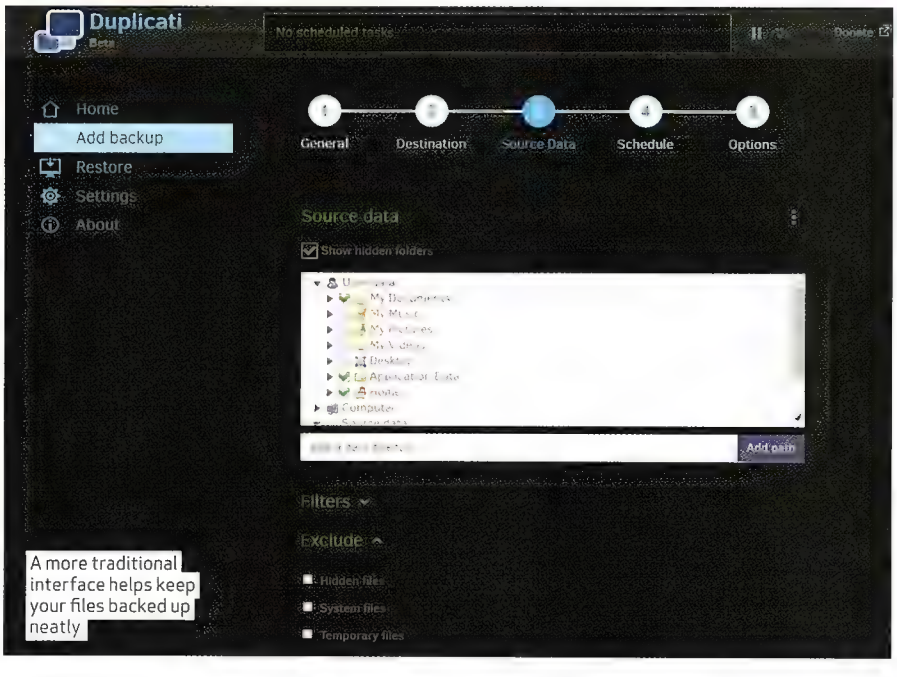
**"If you find the default Windows system too basic or unappealing in general, the world of software has a host of other options you can choose from."**

everything, and continued to expand this with relevant sibling folders, such as Pictures, Music and so on. The idea being that everything that's important to you can be found in one of just a few folders.

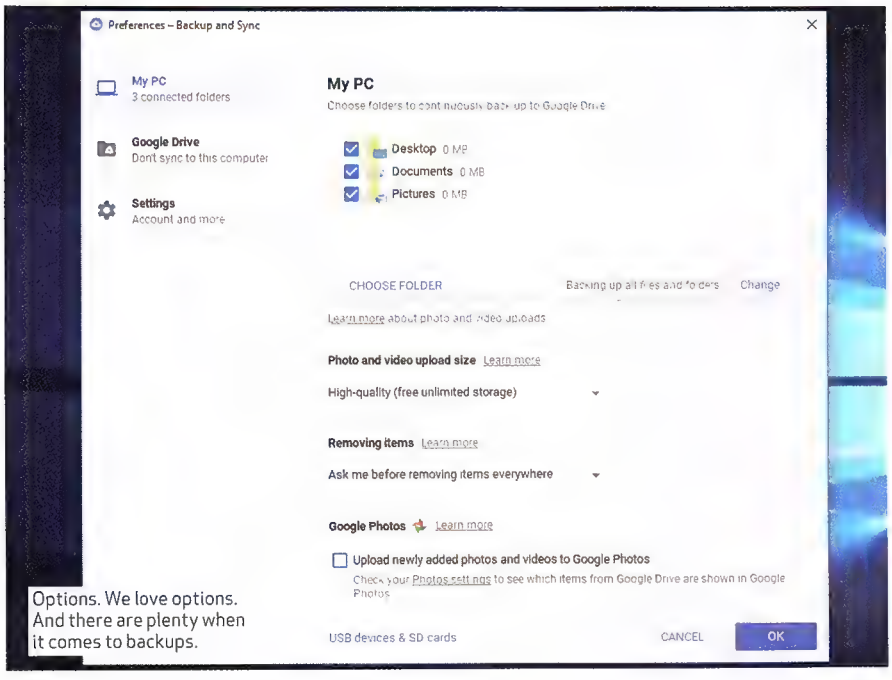
The dirty reality is that all of these default system folders are stored in the user's main system folder, typically under C:/Users/<user name>, alongside the Desktop contents, temp folder, any random program folders, and additional program settings under the hidden AppData folder. Typically, any default backup regime will save the entire folder for an individual user. If you're storing files elsewhere, you'll need to manually add these to your backup. Talking of which...

Windows 8 (and onward) Backup uses the File History system, which is pretty neat, but isn't the smartest-looking thing to set up. It requires an external drive or network share to function – we'll get on to destination options shortly. Open the Start menu, type "Backup" and select 'Backup Settings'. If it's not configured, there will be a + symbol asking you to add a drive; once a drive has been added, this changes to a simple on/off toggle. The grown-up settings can be found in the traditional 'Control Panel › System and Security › File History'. If you want to add a network share, do it through 'System and Security › File History › Select Drive › Add Network Location'.

With a drive added, click 'More Options'. You can instigate a backup immediately here, and choose how often to perform the backup, and how long to keep it. Plus, you're able to remove any unwanted folders – as discussed, these are largely the contents of C:/Users/<user name>. Do you really want to include Downloads or




A more traditional interface helps keep your files backed up neatly


Preferences – Backup and Sync
My PC
3 connected folders
Google Drive
Don't sync to this computer
Settings
Account and more
My PC
Choose folders to continuously back up to Google Drive
Desktop 0 MB
Documents 0 MB
Pictures 0 MB
CHOOSE FOLDER
Backing up all files and folders
Change
Learn more about photo and video uploads
Photo and video upload size Learn more
High-quality (free unlimited storage)
Removing items Learn more
Ask me before removing items everywhere
Google Photos Learn more
Upload newly added photos and videos to Google Photos
Check your Photos settings to see which items from Google Drive are shown in Google Photos
USB devices & SD cards
CANCEL
OK
Options. We love options. And there are plenty when it comes to backups.

everything that's on your Desktop? The neat trick with File History is that once it's up and running, you're able to right-click any file, select 'Properties > Previous Versions' and restore past versions that have been backed up. It's like System Restore, but for files. To do mass restores or rollbacks, open the Start menu, type "Restore your files" and open the Control Panel setting. Just select the folder or files you'd like to restore, and off you go!

## ALTERNATE OPTIONS

Of course, if you find the default Windows system too basic or unappealing in general, the world of software has a host of other options you can choose from. We're going to suggest two worth your time. The first is Duplicati (**www.duplicati.com**). This is a fine upstanding LGPL-licensed open-source, cross-platform straight backup application, which supports a wide range of local and cloud targets. If you have to deal with other systems, it's handy to know that your backup client can deal with Windows (64 and 32-bit), MacOS, and Linux (Deb and RPM packages), plus there's a Synology NAS build, too.

By default, Duplicati offers a serviceable browser-based interface – thankfully with a Dark theme option – giving away its more powerful features. There is a command-line version, too, for those who fancy weaving it into their PowerShell scripts.

What's of real interest with Duplicati is the wide range of supported backup targets and protocols. There's traditional (S)FTP/SSH and WebDAV, and then, more useful for a newer generation, a bunch of common cloud services, including Amazon S3, Microsoft Azure, Box, Dropbox, Google Drive, Mega and so on.

If you're wondering why Windows network shares aren't specifically listed here, fear not: When choosing the destination with 'Local Folder or Drive' selected, click the 'Manually Type Path' option. You need to enter the server name and path to the networked backup folder, plus add any required login details in the username/password boxes below this. The standard format is "\\<servername>\<path>". If you're not sure, open up File Explorer, browse to the remote server folder, then click in the address bar – Windows then helpfully displays the raw address, which you can copy and paste into the box. Ensure you use the 'Test Connection' button before moving on.

That's the basics of this powerful little tool, but don't overlook the little extras, such as bandwidth throttling in the top-right, plus additional settings to filter files based on size and system attributes.

We should mention another backup tool: the worthy SyncBackFree, part the SyncBack range by 2BrightSparks (**www.2brightsparks.com**). The SyncBack range is immensely powerful, and even the free version – limited to FTP and local networks – can become overwhelming with its available options. What SyncBack offers over Duplicati, alongside standard backup,

## RAID is not backup

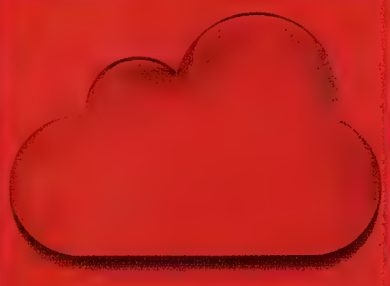
**Simply running RAID on your desktop system is not backup.**

A backup is a separate copy, stored on a separate system, and ideally you have another copy offsite. You can follow the line of disaster: If your main system explodes, you have a backup on your spare system, if that system explodes, you have a copy on your main system; but if your home explodes, you have a copy offsite. Enough exploding.

What RAID is great for is redundancy, and as we all know, redundant systems are there to increase system reliability through duplication of functions.

In the case of RAID 1, 5, and 6, an entire drive can fail, and the parity (or mirror) the system uses can enable it to recover the local data. RAID 5 can handle a single drive failure from three or more drives, while RAID 6 can handle two drives failing running with four drives or more — this was added because the time to rebuild large arrays inevitably increases the window of opportunity of a second drive failing.

What RAID doesn't do is create a backup, so if the entire RAID fails — and it does happen — you lose all your files, and recovering data from a RAID is a huge pain. It also doesn't necessarily protect against bitrot — the undetected deterioration of digital data on a storage medium. Advanced filesystems, such as ZFS and Btfs, offer checksum protection, but these aren't a realistic option for Windows users. So we're back to suggesting you need a real backup to secure data safely.



## Free your cloud

Here at APC, we wouldn't describe ourselves as cheapskates, but you're more likely to find our Managing Director sprinting off home at the end of a working day, rather than risk the chance he has to pick up a bar tab.

There is certainly a number of free cloud services that we recommend you could consider for backing up specific types of files, which offer a useful offsite alternative and other services. However, if data is truly precious to you, we strongly recommend you consider paying for a suitable service — if a product is free, then you're the product.

To kick things off, Google Photos offers unlimited free photo storage when you opt to use its 'compressed' service. Google has done a ton of advanced research into image compression, and you're not likely to spot any difference. It also offers free 1080p video storage for clips under 30 minutes. It's suppose to tie in with Android device usage. A solid alternative is Flickr, now owned by the non-hacked SmugMug, rather than Yahoo, and you get 1TB of storage, which is not to be sniffed at.

Spinning back to Google, Google Play Music offers storage for 50,000 tracks for free, if you're happy to be annoyed by promos to pick up its paid-for unlimited service now and again. It supports MP3, AAC, WMA, FLAC, Ogg and ALAC, and individual tracks can be up to 300MB in size. There's a desktop uploader tool, which can churn away, uploading in the background.

For straight storage, the go-to free service tends to be **Mega.nz**, which provides 50GB of free storage via its pretty slick desktop and mobile systems. You then have a host of services such as Box, pCloud, and MediaFire, which offer around 10GB for free, with paid-for options on top, alongside what Microsoft OneDrive and Google Drive have to offer.

are Sync and Mirror modes. Synchronisation isn't true backup in the technical sense — we're not going to get into that here — but if you're after a solution with more flexibility, SyncBack is worth a look.

If you want to implement a quality local backup system, you need a reliable way to store your files. You could just plug in any old USB drive, and use that as a backup — there's nothing explicitly wrong with that, and it's certainly better than nothing. The chances of both your desktop and the USB drive failing are slim, unless there's a fire, flood or other natural disaster.

An external device with RAID 1 would be our next favourite; there's a wide range of desktop drives that offer dual-drive support with mirroring — this enhances your backup with redundancy, and should service most home users. The next step up would be an entry-level NAS box, which has the advantage of always being available, and supports additional services, such as being a cloud-based offsite uploader. It also makes its location more flexible, because Ethernet runs can easily be up to 90m in length, so you could stash it elsewhere in your home.

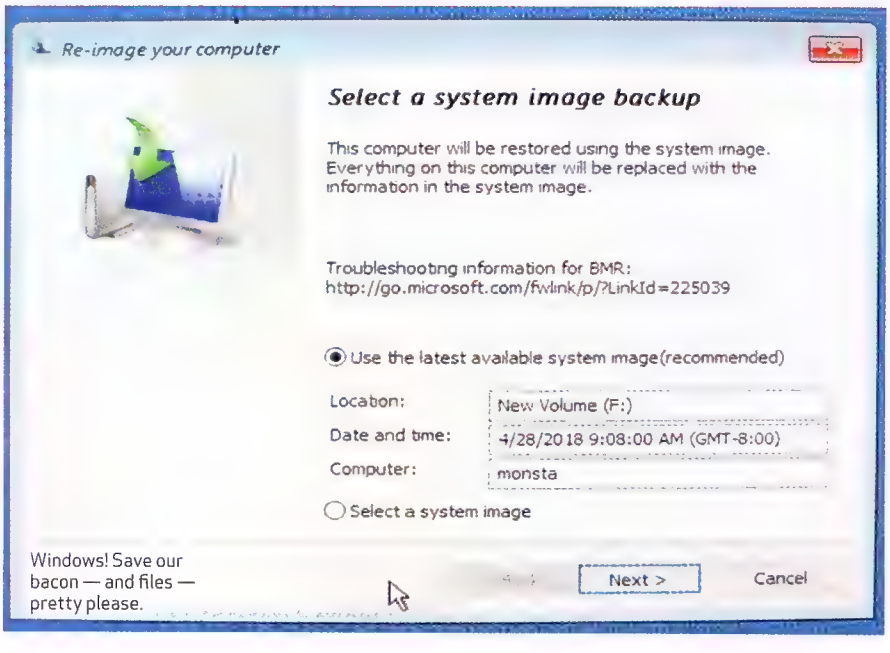
### INTO THE CLOUD

If you're looking for the perfect backup trifecta, the final vertex is offsite backup. For most people, this means a cloud-based third copy of any files, photos, or other settings. Cloud storage has gone crazy over the last decade, and transformed into a multi-billion-dollar business. If you need major offsite backup, there are plenty of cloud options to choose from, such as Amazon S3/Glacier, Rackspace, Microsoft Azure, IBM, Oracle and more.

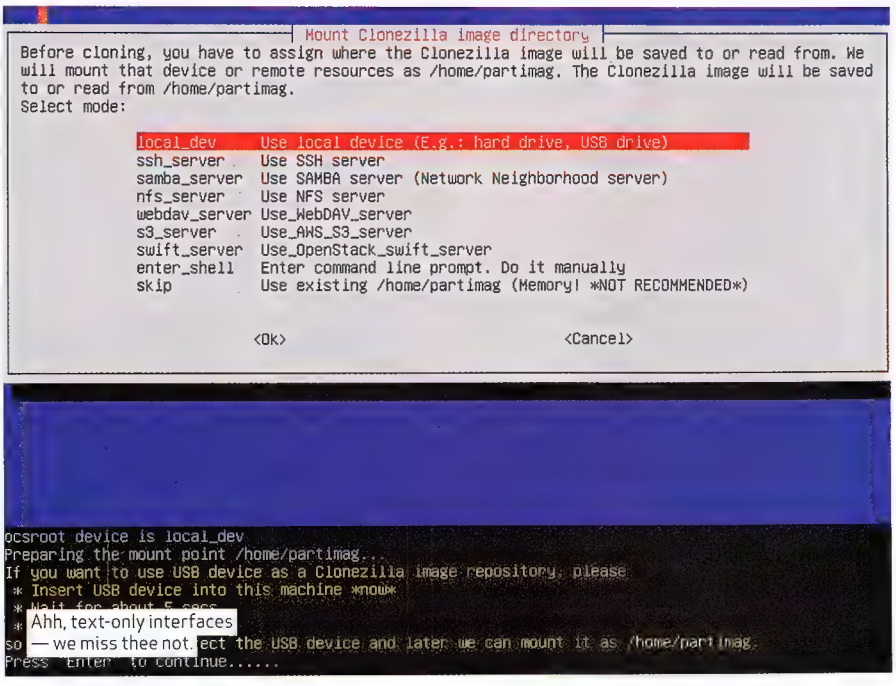
Those are designed more for enterprise-level backup, though, and we need to concentrate on straightforward consumer-level solutions that bundle the cloud storage with a desktop sync tool. Microsoft helpfully — and without any ulterior motive — includes its OneDrive tool with Windows. This very handily automatically offers cloud synchronisation for anything stored in the OneDrive folder. Dive into the OneDrive Notification icon, and you can extend this 'backup' protection to the standard Documents, Desktop and Picture folders, too. As long as your precious files are stored here, you're going to have potential cloud backups of them as well. Microsoft offers 5GB of storage for free, while 50GB costs $2.99 per month, or if you sign up for Office Online, it throws in 1TB for $99.99 per year or $10 per month.

If you're locked into the Google ecosystem, you'll likely want to try Google Backup and Sync (**www.google.com/drive/download**). It's more flexible than OneDrive for the simple fact it includes the option to add any folder to be synchronised with your account. As we mention in the boxout (left), it also includes the ability to upload photos and utilise unlimited storage, if you use its compression program.

**"If you're locked into the Google ecosystem, you'll likely want to try the Google Backup and Sync tool."**


Re-image your computer
Select a system image backup
This computer will be restored using the system image. Everything on this computer will be replaced with the information in the system image.
Troubleshooting information for BMR:
http://go.microsoft.com/fwlink/p/?LinkId=225039
Use the latest available system image (recommended)
Location:
New Volume (F:)
Date and time:
4/28/2018 9:08:00 AM (GMT-8:00)
Computer:
monsta
Select a system image
Next >
Cancel

Windows! Save our bacon — and files — pretty please.


Mount Clonezilla image directory
Before cloning, you have to assign where the Clonezilla image will be saved to or read from. We will mount that device or remote resources as /home/partimag. The Clonezilla image will be saved to or read from /home/partimag.
Select mode:
local_dev Use local device (E.g.: hard drive, USB drive)
ssh_server Use SSH server
samba_server Use SAMBA server (Network Neighborhood server)
nfs_server Use NFS server
webdav_server Use_WebDAV_server
s3_server Use_AWS_S3_server
swift_server Use_OpenStack_swift_server
enter_shell Enter command line prompt. Do it manually
skip Use existing /home/partimag (Memory! *NOT RECOMMENDED*)
<Ok>
<Cancel>
ocsroot device is local_dev
Preparing the mount point /home/partimag...
If you want to use USB device as a Clonezilla image repository, please
* Insert USB device into this machine *now*
* Wait for about 5 secs
* Ahh, text-only interfaces
so — we miss thee not. ect the USB device and later we can mount it as /home/partimag.
Press "Enter" to continue.....

## SYSTEM IMAGES

It's a time versus effort calculation: the time it takes to make and restore an entire system image versus installing from scratch. While it might sound faster, remember that there will be a host of updates and patches that will need to be applied, and a fresh install can handle that far more smoothly. Microsoft tried to push people away from system images when it introduced Windows 8, by entirely killing off the long-standing, tried and tested Windows 7 Backup and Restore.

It's a fine system that created an image of the system drive on a local drive, network share, or a series of DVDs via shadow copy — so you could continue working on the system. It was 'easy' to restore this image via the default system rescue disk, which you're prompted to make when an image is completed, and you very much should do.

After much wailing and gnashing of teeth, Microsoft thankfully restored the system to Windows 8, and it remains tucked away in Windows 10 under the traditional Control Panel section in 'System and Security > Backup and Restore (Windows 7)'.

A limitation with a Windows system image is that there are no options: It images the entire system drive, and you can't restore individual files. It also only backs up to the root of a selected drive, while it insists on a network username and password for network shares — even if it has public access rights. In this case, you need to provide the remote system's standard username and password.

Windows also offers an option to create a bootable recovery DVD, with which you can restore the system image. We strongly suggest you create one, because in the past we've had headaches attempting to restore images that differ from the installed version of Windows. Label it clearly, and store it somewhere safe alongside the system image.

To recover your PC, you have two options: one is to reboot using your recovery DVD, the other is to start Windows in Recovery mode. If Windows can run, open the Start menu, type "Recovery", choose 'Recovery options' and select 'Restart Now' under 'Advanced Startup'.

Choose 'Troubleshoot > Advanced Options > System Image Recovery'. Windows then reboots into its Recovery mode. You need the drive with the system image on plugged into your computer. Follow the prompts, and your system image will be restored.

There is a Linux-based open-source project called CloneZilla (back when everything was called <name>zilla) that we're a little hesitant to recommend. It's more flexible than Windows Backup imaging, in terms of your absolute control in what is imaged and how it's stored, but it's less convenient, because you have to boot a live disc, and more annoyingly, it's tediously convoluted in that way that only Linux types can manage. If you're not put off by drives being called sda, and partitions being sda1 or sda2, it makes getting a drive imaged or cloned easier. Depending on your definition of 'easy'.

Now you know how to get everything backed up, cloned, imaged, and sent into the cloud with as little hassle as possible, do it! ■

## Backup theory

Not all backups are made equal; there are different types of backup depending on what the approach is and what the aim is.

The type of backup can alter the type of transfer and how it's stored, so it's worth having a quick blast through the approaches.

We've been largely concerned with **active** backups in this article, so it makes sense to cover those first. As the name suggests, these are duplicate files of actively used system or data files. These contrast with archive backups, which we'll cover shortly. An active backup attempts to back up all files, and then maintain an up-to-date version or versions of these according to a schedule selected by the user.

**Archive** backups are only concerned with data that's no longer actively used, but copies are required to be retained. They're essential for businesses, but also for individuals who want to safely retain financial or legal records, message logs and so on. They require a different approach to that of active backups in terms of reliable long-term storage.

**Synchronised files** are a modern spin on the active backup, and enable a file to be accessed from any location, or remain the same in multiple locations. Dropbox is a classic example, but modern 'office' services, such as Google Drive, provide something similar, with multi-user access and versioning.

Synchronised services typically require an internet connection to run the backup and be accessed, unless a local service is being run, such as OwnCloud or Nextcloud. An active backup is best run over a local network or wired drive, though for more limited purposes, a cloud service would be adequate. You would want to consider redundancy on the backup medium, such as RAID. Archives would ideally be stored offsite — a cloud service would be best — and if the data is irreplaceable, a bitrot-aware filesystem, such as ZFS or Btfs, would be advisable.

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# Backing up to the cloud

## Learn everything you need to know about giving your data a spring-clean and then backing it up securely to the cloud.

**There's no excuse for catastrophic data loss these days. In an ideal world, you'll already have a comprehensive backup plan in place, with a minimum of one backup (and preferably two or three, each one isolated from the other). One of these should *ideally* be stored online, taking advantage of cheap, plentiful and easily accessible cloud-based storage to house your data in a physically separate location to your PC.**

If you've not yet explored the benefits of backing up your critical documents, photos and other data to the cloud, this is the feature for you, helping you choose the right cloud provider for your needs. But there's also plenty here if you're already backing up to the cloud: you'll find out how to trim your data to maximise the available space, and learn some clever tips and tricks for managing your online storage.

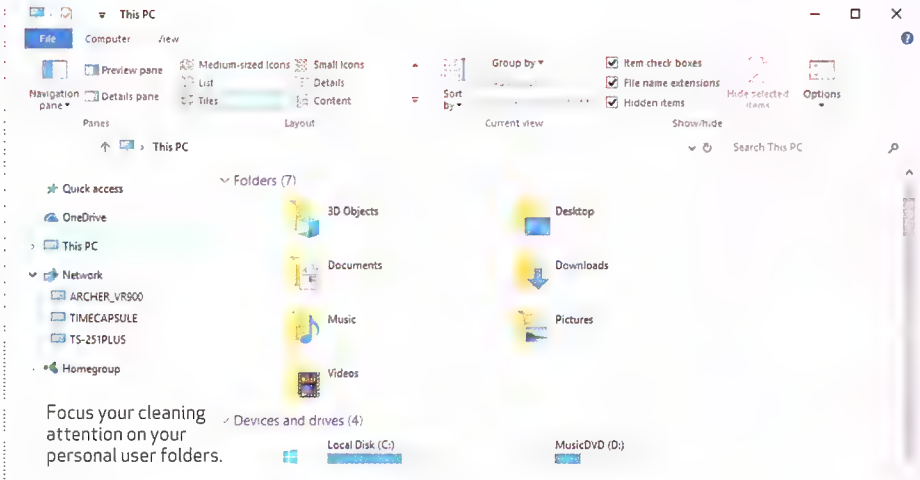
But what if you don't like the idea of storing your data with a third-party provider? Worry not, because we've also found the time to explore housing a cloud-like backup – with all the advantages that it offers, such as access from anywhere and the ability to sync between multiple computers – within your own home. Ready to give your precious data an extra layer of essential protection? Let's turn the page and get started.

# Clean up before backup

## Streamline the files and folders you need to store online before backing them up to save drive space and speed up the process.

**Your online backup space is likely to be limited – particularly if you're relying on free storage – so it obviously makes sense to go through the files and folders you want to back up before you start uploading. Some judicious pruning now won't simply give you more room to work with, it'll also speed up the initial backup process as less data will have to be uploaded.**

A complete spring-clean of your PC isn't required here – instead, you want to focus all your attention on the folders you plan to back up to the cloud. Typically, these will be your user folders – Documents, Photos and so on.




Focus your cleaning attention on your personal user folders.

### REMOVE DUPLICATES

One obvious way you can reclaim space is through the removal of duplicate and similar files. The step-by-step guide on the page opposite reveals how to use two free tools in tandem – the first (Duplicate Cleaner Free) covers all duplicate files, while the second (AntiDupl) enables you to weed out similar image files too, perfect for those times you took a dozen photos only to not bother going through them all to pick out the best one.

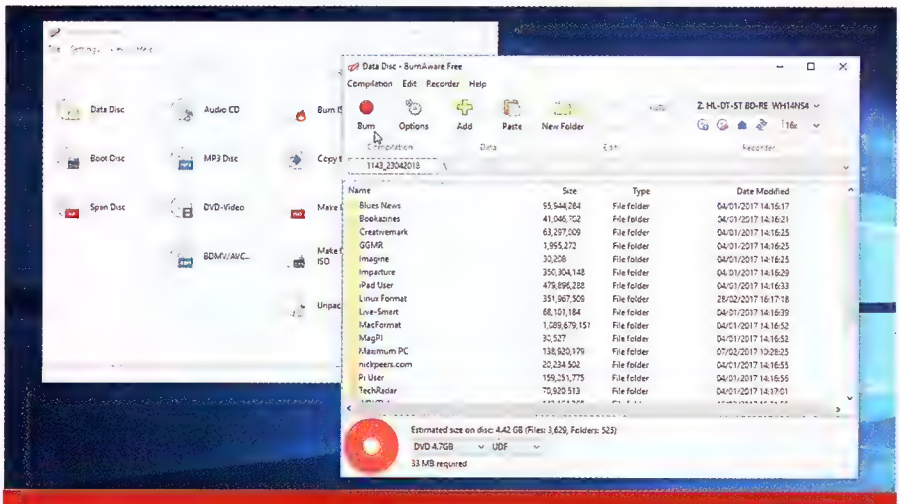
Some tips when using AntiDupl: one, the results display photos in groups of similar/duplicate snaps, with the top-most photo in the list deemed the 'master' and therefore untouched. By default, it's assumed you'll want to keep this top photo, but previews on the left coupled with a series of action buttons allow you to change what happens. We recommend selecting Help, then help to access the online manual, then select 'Table of Results' for a comprehensive description of what to do. If you don't like the way the previews sit to the left of the results list, choose 'View > View mode of results > Table of horizontal pairs' for a better view.

### ARCHIVE OLD FILES

Another way to save space is to decide whether all your files need to be uploaded to the cloud. It may be that older files can be excluded from this backup by archiving them to a different medium – an external drive, say – which is then stored away from your PC in a safe place. Alternatively, save space by zipping up old files or folders you rarely – if ever – access. This can reduce their size considerably while still giving you access to the files in future – we recommend ZIP over other compressed file formats because it's a universal format and support for it is built right into Windows.

ZIP files can be picky about file names, so if your files are rejected due to the presence of certain characters such as bullet points, use a file-renaming tool like Advanced Renamer (**www.advancedrenamer.com**) to quickly find and replace offending characters with more acceptable substitutes (or simply remove them completely).

As a side-note, you can search the contents of ZIP files that have been indexed by Windows Search, but if your ZIP files reside in a non-indexed location (typically outside your user folders), open File Explorer, switch to the ribbon's View tab and click Options, then the Search tab and tick 'Include compressed files...' then click OK to include them in future searches.



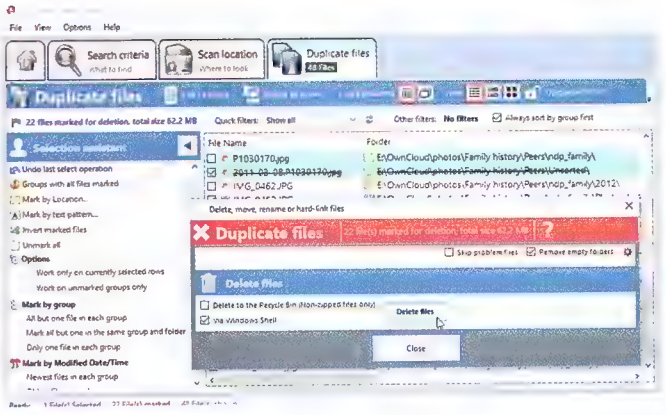

### Back up your archives

#### When is a backup not a backup?

When it's the only copy of a file you have. Archiving data usually means transferring it to a new medium for long-term storage — an old external hard drive or DVD or Blu-ray disc, for example. Make sure you remember to back up your archive, too — burn another disc and store it somewhere separate to the original archive to protect against fire or theft. If you're compressing files to save space, make sure you keep a backup copy of the file in its original format, in case the ZIP archive becomes corrupt.

# How to:

## Remove unnecessary duplicates

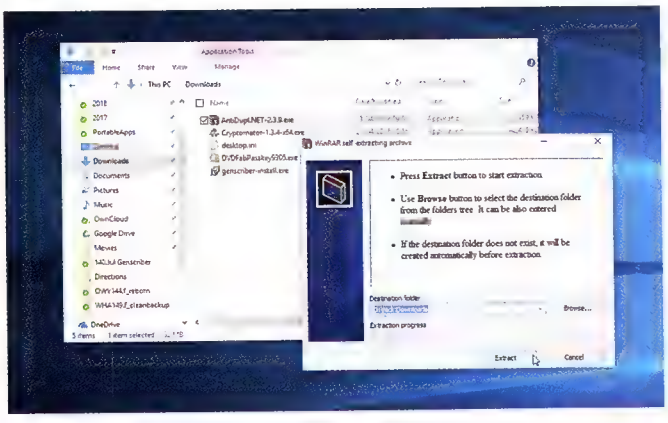


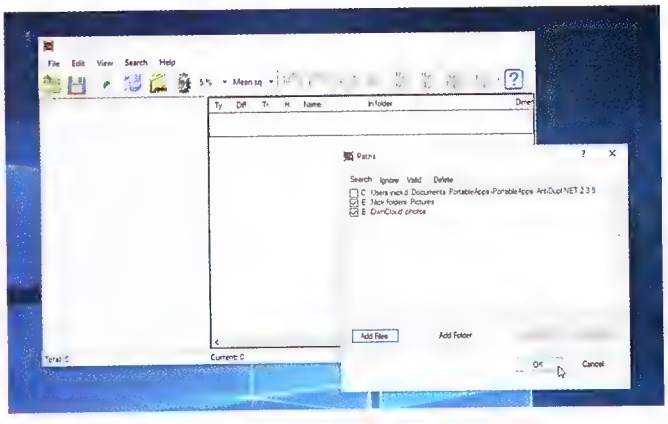

**1** REMOVE DUPLICATE FILES

Duplicate Cleaner Free (**www.digitalvolcano.co.uk/duplicatecleaner.html**) will help you track down identical copies of files based on their content as well as their filenames. Simply add the parent drive or folder containing the files you wish to backup and then run a full scan.

**2** REVIEW AND REMOVE

Matching files are conveniently colour-coded for easy identification. You can manually choose to remove the duplicates or make use of the filters on the left to choose files based on a specific setting, such as a particular folder. Once done, you can remove your unwanted files.


Press Extract button to start extraction
Use Browse button to select the destination folder from the folders tree. It can be also entered
If the destination folder does not exist, it will be created automatically before extraction
Extract
Cancel

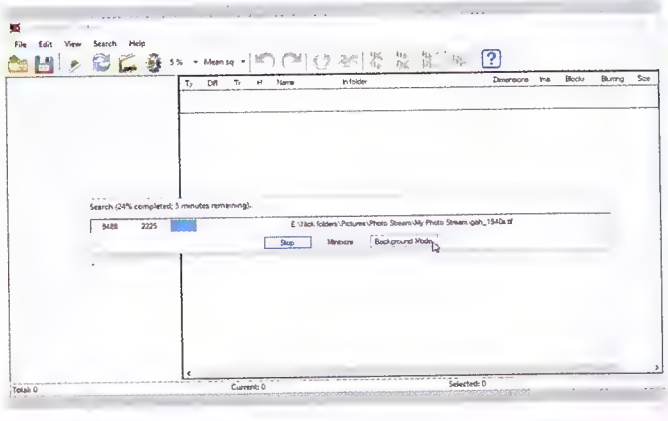



**3** REMOVE SIMILAR IMAGES

If you're the kind of person who takes multiple photos on your camera or smartphone in search of the perfect one, the chances are that dozens of similar — but not identical — images exist on your drive. Identify and remove these with the help of AntiDupl (**ermig1979.github.io/AntiDupl**).

**4** SET SEARCH PARAMETERS

After downloading and extracting AntiDupl (it's a portable app), launch it and choose 'Search > Options' if you wish to include mirrored and rotated images in your search. Then choose 'Search > Paths' to add one or more drives, folders or even individual files to your search.



**5** SCAN AND REVIEW

Click the Play button and be prepared for a long wait. You can click 'Background Mode' to minimise the program to the Taskbar notification area if you want to also do other things on your PC at the same time. Once complete, AntiDupl will pop up to list all duplicate and similar files.

**6** REMOVE SIMILAR ITEMS

Click the appropriate button for each result and it'll vanish from the list, replaced by the next. Keep working through the list – use 'Ctrl-click' to select multiple items to speed things up.

If you need to, you can close the program and return to it later, picking up where you left off.

# Pick your cloud provider

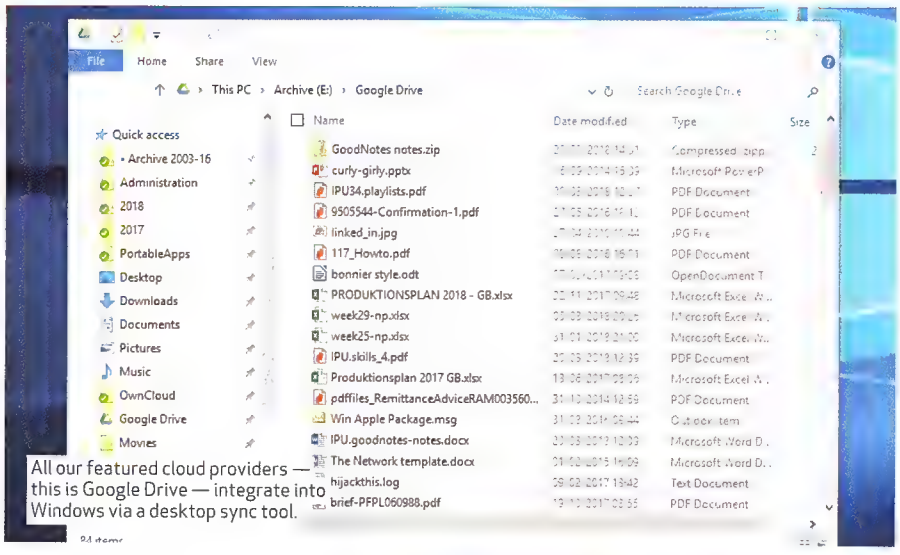
## Next step: choosing where to store your files online. Here's what to look for, plus a list of popular providers for you to consider.

**When it comes to storing your files in the cloud, you're presented with a bewildering array of options. There are literally dozens of providers out there, offering a mixture of free and paid-for storage. In the table on the page opposite, we've summed up some of the best-known services. Of these, Microsoft's OneDrive is integrated into both Windows 8.1 and Windows 10.**

### FREE STORAGE PLANS

If your data storage needs are modest – basically, all your documents, a relatively large collection of photos, perhaps a portable applications collection and little or no video or music – then there's no real need to pay for online storage at all. All the major providers offer free storage – these top out at 15GB per provider, although you can, of course, sign up to multiple providers and spread your data across them to easily boost your free storage to 50GB or higher (see the box below).

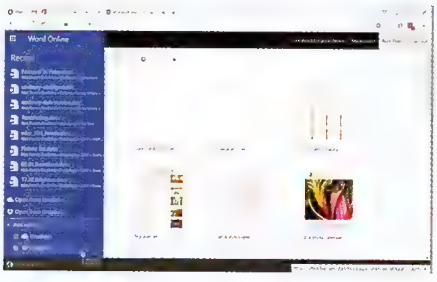
How can you access your data? All the major providers featured in the box below support Windows, Mac, iOS and Android platforms through desktop or mobile apps. Google Drive and Dropbox also offer Linux desktop clients, and you can access your files (and upload them) through any web browser.



All our featured cloud providers — this is Google Drive — integrate into Windows via a desktop sync tool.

The best approach is to install the Windows client, then store your files inside the cloud folder that's created (this is typically found in your personal user folder, but check during setup to see if you can choose an alternative location if you wish). Anything inside here is automatically uploaded to your cloud storage with changes synced in real-time in the background to ensure that the latest versions of your files are always backed up.

Another reason for hosting files in the cloud is to share them with others.


Dropbox users can make use of Office.com to directly access and edit their office documents.

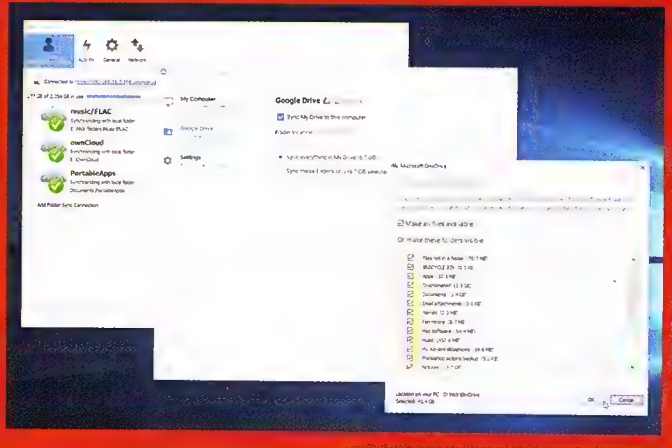
## Combine cloud backup services

### Why pay for one backup service when you can spread your files across multiple providers using their free accounts?

You might find that one account — OneDrive — is particularly suited to collaboration, while Google Drive or Box's more generous free plans provide enough space for housing your digital music online, for example.

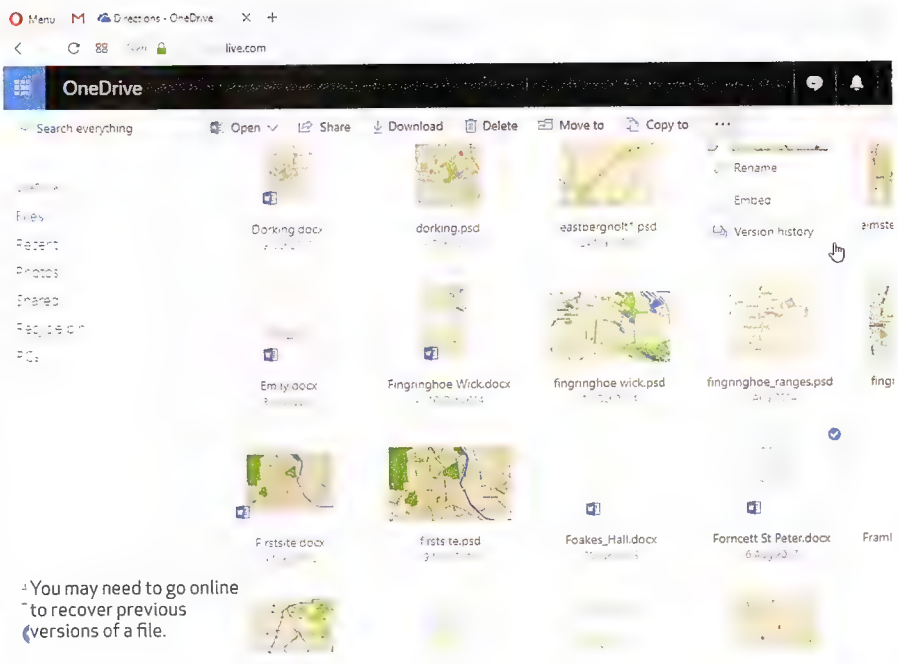
You can sign up with as many providers as you like, but each desktop sync app consumes that bit more system resources along with internet bandwidth. How many you can run side-by-side will depend on the speed of and spec of your PC. If you're running less than 4GB RAM on a non-SSD drive, for example, you may struggle running more than a couple together at once.

It's a good idea to set each provider up separately and enable each one to perform an initial sync of your data without interference from the others. Once the bulk of your files have been uploaded, network and system performance should noticeably improve once only minor changes are being made to your backups.


Our test PC runs three cloud services side-by-side — you should be able to manage this with 4GB RAM and a fibre broadband connection.

You want to be able to share individual files on a read-only basis or create a shared folder that people can make changes to. Files and folders can be opened up to anyone, or you can limit access to individual users, who will need their own account with that cloud provider to access the files in question. One caveat: if you share folders with others – or they share folders with you – those folders become part of your cloud account and any files inside count towards your overall storage.

If you want to be able to easily collaborate on documents with others, choose a service that can integrate with Office 365 (OneDrive) or an online office app. Examples of the latter include Office.com (OneDrive or Dropbox – if using the latter, you need to click 'Add a place' to link it to your Office account) and Google's cloud-based office apps, Docs, Sheets and Slides (Google Drive).



You may need to go online to recover previous versions of a file.

## WHAT ELSE TO LOOK FOR

Cloud storage providers offer different ways to protect your data during transfer and while it's stored on their servers. If there's data you're particularly sensitive about, look for a cloud provider that offers 'zero-knowledge' encryption, such as **Sync.com**. This basically means your files are encrypted at your computer or device before being sent to the cloud, and that your cloud provider has no access to the encryption key that is being used.

The theory is sound, but you're still relying on the honesty of your cloud provider's software to encrypt your data in the way it claims to do. If you want to add your own encryption to any cloud folder, then turn the page for additional encryption tips, or turn to page 54 to investigate a different approach to backing up your data altogether – namely hosting your own cloud backup.

Another handy feature to look for is 'file versioning', whereby multiple versions of your files are stored online, enabling you to rollback individual files to earlier copies if necessary. It works in a similar way to File History, although in most cases you'll need to log on to your cloud account through your web browser to access past versions of the files that you have saved to the cloud.

Should you upgrade to paid-for storage, find out what happens to your files if your subscription lapses. In most cases, you should find you have read-only access to your files, but can't upload any more – you can, though, download them if needs be. Once you delete enough files to bring your storage under the free quota, the account should start functioning again. Check to see if there's a time limit before your provider starts deleting your files – Google Drive and Dropbox don't have any limits, for example, but OneDrive will freeze your account after an extended period while Amazon will start deleting files (the most recent uploads first) after 180 days.

## Cloud storage at a glance

| | FREE STORAGE | FREE UPGRADES? | FILE VERSIONING | PAID PLANS |
|---|---|---|---|---|
| ONEDRIVE | 5GB | 0.5GB FOR UP TO 20 REFERRALS (50 MAX 10GB) | UNLIMITED | 50GB ($2.99/M*)<br>1TB ($10/M* WITH OFFICE 365 PERSONAL)<br>1TB FOR UP TO 5 USERS ($13/M* WITH OFFICE 365 HOME)<br>10GB FILE SIZE LIMIT |
| GOOGLE DRIVE | 15GB SHARED WITH GMAIL | GOOGLE PHOTO UPLOADS FREE IF HIGH QUALITY | 30 DAYS | 100GB ($2.49/M*)<br>1TB ($12.49/M*) |
| DROPBOX | 2GB | 0.5GB FOR REFERRALS UP TO 16GB | 30 DAYS | 1TB ($11.58/M*) |
| BOX | 10GB (250MB PER FILE) | NO | PAID FOR ONLY (10 VERSIONS) | 100GB ($14/M).<br>5GB FILE SIZE LIMIT |
| AMAZON DRIVE | 5GB | PRIME USERS GET UNLIMITED PHOTO STORAGE | NONE | 100GB (US$11.99/YR)<br>1TB (US$59.99/YR) |
| SYNC.COM | 5GB | NO | 30 DAYS (FREE)<br>UNLIMITED (PAID FOR) | 500GB (US$49/YR)<br>2TB (US$96/YR) |

* Annual plans cost the equivalent of 10x monthly payments

# Cloud backup tips

## Whether you're new to backing up your files online or an old hand, we have some handy hints to share...

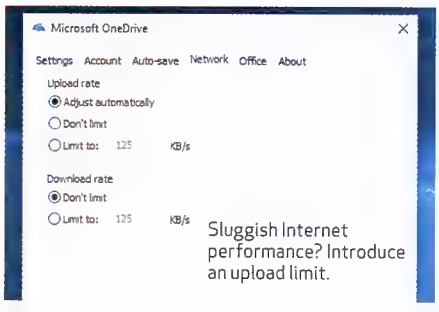
**Once your cloud folder is up and running, it's tempting to adopt the 'set it and forget it' approach, but there are plenty of little tweaks you can – and should perform – to help improve your experience. The first tip is particularly pertinent if you're limiting yourself to free backup plans – and that's be selective about what you back up. Focus on your critical, irreplaceable files – documents, photos and home videos (but not other digital media you can recreate from elsewhere). This is in addition to restricting your use of shared folders as explained previously.**

During your initial backup, you may find your internet connection slows to a crawl or even occasionally falls over, prompting a reboot of the router. This is often down to your cloud provider's desktop sync tool hogging all available upload bandwidth. The trick is to configure an upload limit via its settings tool – in OneDrive for example go to Settings, choose the Network tab and tick 'Adjust automatically' under 'Upload rate'. Google Drive users should visit 'Preferences > Settings > Network Settings' and manually set an upload rate that's no more than 80% of your connection's total upload speed (find this out via **www.speedtest.net**).

### INTEGRATE WITH WINDOWS

If you want to integrate your cloud storage into your Windows user folders, the best thing to do is first create the relevant sub-folder – such as Documents, Photos and so on – inside your main cloud folder. Next, open File Explorer to This PC, right-click Documents and choose Properties, then the Location tab. Click Move and point this folder to the Documents folder you just created and click Apply, moving data when prompted. This ensures easy access to your files and a guarantee they'll be backed up online too. Repeat for your other user folders.

Every now and then you may encounter a file conflict error – your cloud provider discovers a disparity between the version on your computer and the one in the cloud. Always act to resolve these at the earliest opportunity to prevent multiple copies of files clogging your drive space. You should see two copies of the same file appear in File Explorer – one will be clearly marked as a conflict. Compare this to the original (try a tool like WinMerge from **winmerge.org**



Sluggish Internet performance? Introduce an upload limit.

if you're struggling to spot the differences), then delete the file you don't want to keep and, if necessary, rename the other file to the original filename.

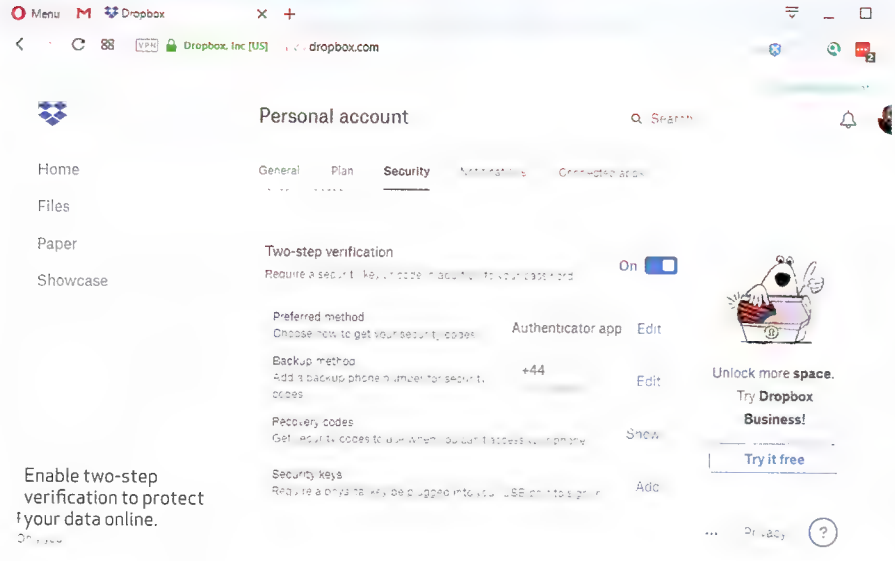
### ENCRYPT SENSITIVE DATA

While your data is encrypted prior to being uploaded to your cloud provider, question marks remain over the security of this data since, in most cases, your provider has access to your encryption keys, which could be passed on to a third party. The step-by-step guide on the page opposite reveals how to use Cryptomator to set up an encrypted vault inside your cloud folder, putting your data out of reach of anyone online who doesn't have your Cryptomator password. You can set up multiple vaults – we recommend keeping an unencrypted copy of your files on your local hard drive in case something happens to your vault.

You'll need to install Cryptomator alongside your cloud sync software or app on any other computer or mobile you wish to access this data on (apps for Android and iOS cost $6.99 each). When accessing from another PC, click +, followed by 'Open existing vault'. Navigate to the synced folder and double-click 'masterkey.cryptomator', then enter the vault's password.

There's one other way you can protect your online data from hackers – look for extra security checks to prevent others being able to log on to your cloud provider's account should your password become compromised. For OneDrive and Google Drive users, this simply means enabling a check like two-step verification or two-factor authentication (2FA) in your parent Microsoft or Google account; Dropbox users will find the option after signing into dropbox.com through their web browser, clicking their avatar and then choosing 'Settings > Security' tab. You can make this check easier by linking the check to a free app on your mobile, such as Google Authenticator or LastPass Authenticator.

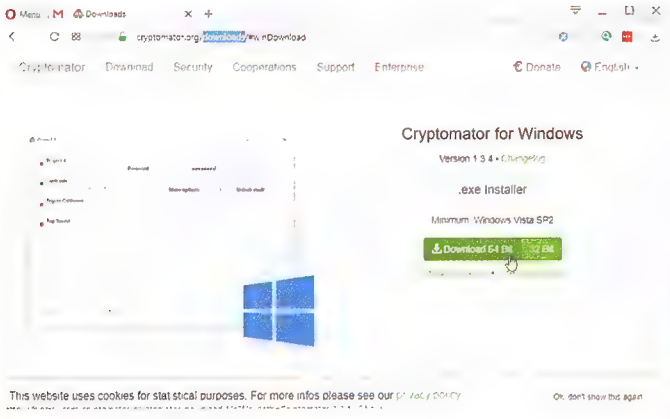
**"This ensures easy access to your files and a guarantee that they'll be backed up online, too."**



Enable two-step verification to protect your data online.

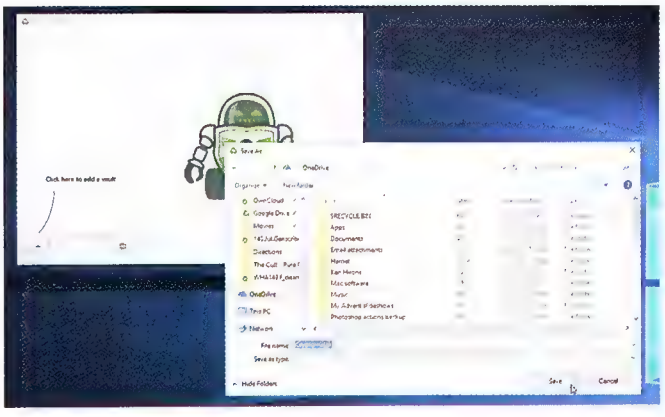
# How to:

## Add another layer of encryption


Cryptomator for Windows
.exe Installer
Minimum: Windows Vista SP2
Download 64 Bit
This website uses cookies for stat stical purposes. For more infos please see our

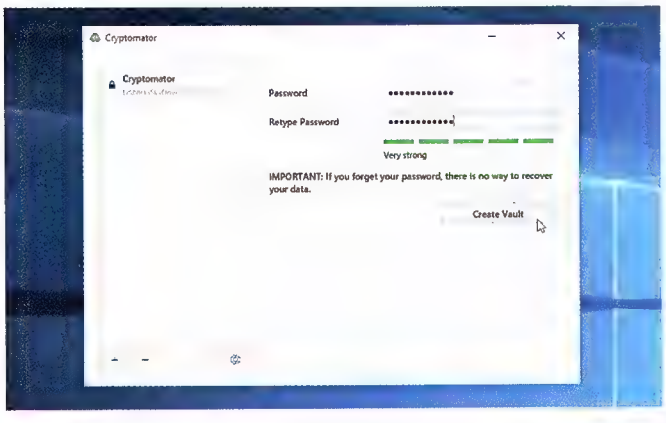
### 1 GET CRYPTOMATOR

Go to **www.cryptomator.org/downloads** and click 'Download 64 Bit' or '32 Bit' depending on your Windows system type (press 'Win-Pause/Break' if you're not sure). Once saved, double-click the setup file and follow the install prompts. Leave 'Launch Cryptomator' and click Finish.



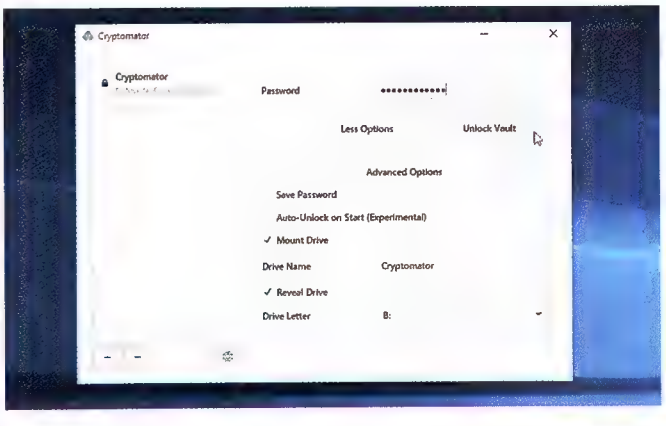
### 2 ADD VAULT

Click '+' as directed by Cryptomator and then choose 'Create New Vault' to create your first encrypted vault. Navigate to your cloud folder, give your vault a suitable name — this will become a folder on the drive, so don't make the name too obvious — and click Save.



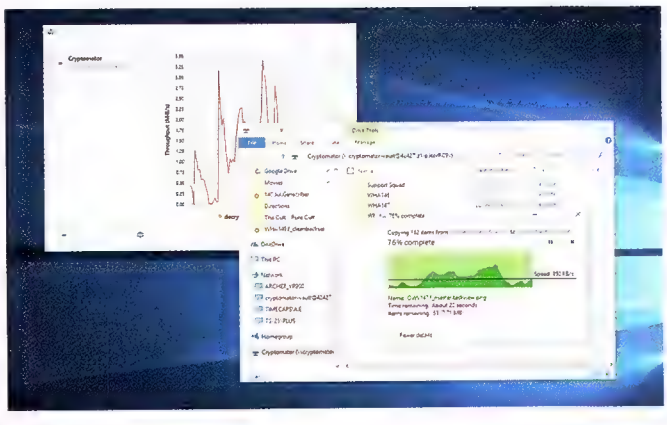

### 3 SET PASSWORD

You'll be prompted to enter a password — you'll need this whenever you link to the vault from a new computer or device, so make it a strong one: a random mix of alphanumeric characters and symbols is best. Record this password somewhere secure, such as a password manager. Click 'Create Vault'.




### 4 TWEAK AND UNLOCK

Click 'More Options' to save the password and automatically mount the drive at startup (only recommended on a secure PC). You can also change the drive name and choose a specific drive letter. Once that's done, enter your password and click 'Unlock Vault'.



### 5 USE YOUR VIRTUAL DRIVE

A new File Explorer window will eventually open pointing to your new virtual drive (it's also accessible via 'This PC' under Network locations) — simply copy or save your precious personal files in here and they will be encrypted securely before being uploaded to the cloud for you automatically.

### 6 LOCK OR EJECT DRIVE

When you're done, you can leave the drive unlocked or — if security is an issue — open the main window and click 'Lock Vault' to close it down (enter your password and click 'Unlock Vault' to bring it back). You can also choose 'Eject Drive' to unmount the drive without logging out.

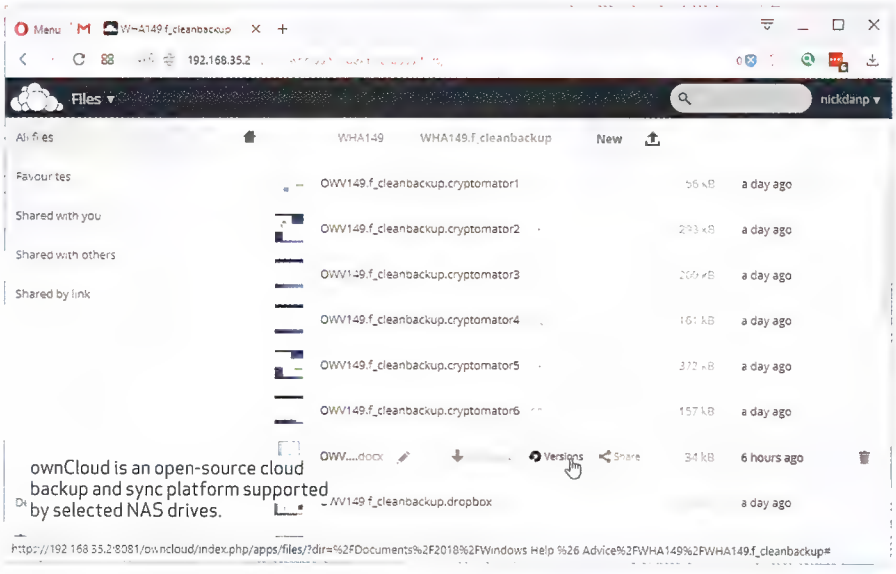
# Host your own cloud

## Don't trust a third party with your data? Discover how to build your own personal cloud service using a network hard drive.

**There are numerous worries about trusting your backups to the cloud. Who can see or access your data? What happens if your cloud provider ceases trading? Several have over the years, and while they usually give you notice, you're still left with the task of retrieving your files and transferring them elsewhere.**

There's also the ongoing cost, particularly if you're storing hundreds of gigabytes of data online. If you've the money for a one-off purchase, you can invest in a 'cloud' network hard drive instead, with the capacity for terabytes rather than gigabytes of data.

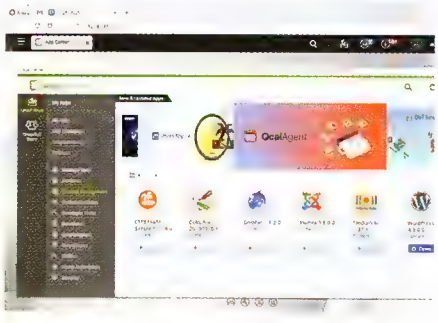
These are like regular network-attached storage (NAS) devices, so accessible to any locally connected computer, but go further by providing cloud-like functionality in the form of a desktop sync tool, remote access (enabling you to get at your data while on the road) and support for mobile devices through dedicated apps. The fact they're on your local network means data transfers to and from the drive are much quicker than over the internet – at least when you're at home. Obviously on-the-road access will be via your slower Internet connection.



ownCloud is an open-source cloud backup and sync platform supported by selected NAS drives.

### PICK A STORAGE DEVICE

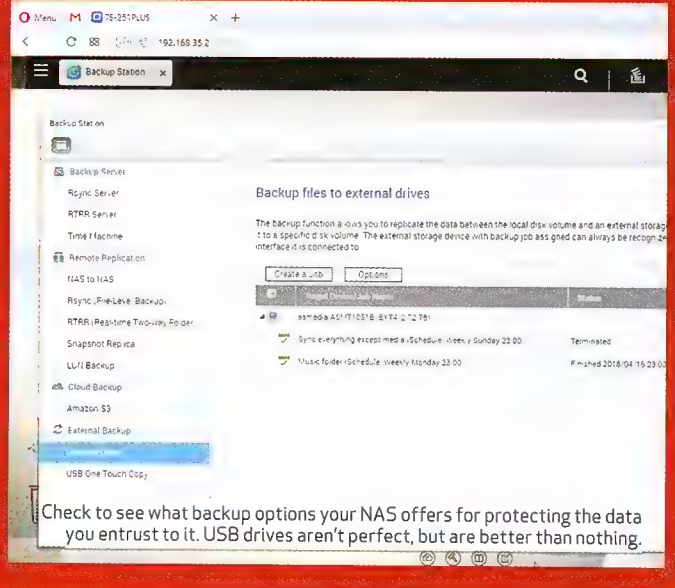
You can check out *APC*'s most recent NAS roundup (where we reviewed four-bay devices) in issue 445, page 52, but there are various things you should consider to help steer you towards a solution that works for you. First, do you want a basic cloud network drive – these restrict you to the manufacturer's own proprietary cloud network tools (My Cloud in the case of Western Digital or Seagate, for example) – or are you looking for something with more power and flexibility? Drives like those offered by QNAP, Synology and ASUSTOR offer


More powerful drives can be used for more than just cloud backup.

### Who backs up your backup?

**Unlike the cloud, your NAS drive doesn't provide multiple redundant backups so you need to take extra steps**

While RAID mirroring on two-bay drives is one touted option, it only protects against drive failure, nothing else, including accidental data loss. Hooking up a USB external drive (either solid-state or hard disk based) provides more redundancy, but neither options will protect against fire or theft. Ideally, you'll set up a backup in a different physical location. You could trust the cloud with a subset of your most critical data, syncing certain files and folders to a Cryptomator vault for extra security. Or you could purchase a second identical model and store that off-site at a trusted friend's or family member's home. Alternatively, persuade them to invest in their own network hard drive and trade spare capacity on your drive for some space on theirs — if both drives support the same kind of remote server (Rsync is a popular choice) then you're good to go. Just locate the appropriate app or tool such as Backup Manager (Seagate) or Backup Station (QNAP) to configure the connection between the two.



Check to see what backup options your NAS offers for protecting the data you entrust to it. USB drives aren't perfect, but are better than nothing.

a wide range of apps and services that enable you to stream music or video, for example, or choose an open-source, platform-independent cloud storage solution such as ownCloud or nextCloud. You can also host your own website, run multiple types of servers from a single always-on device, set up secure Virtual Private Network (VPN) connections and even set up virtual PCs on selected models.

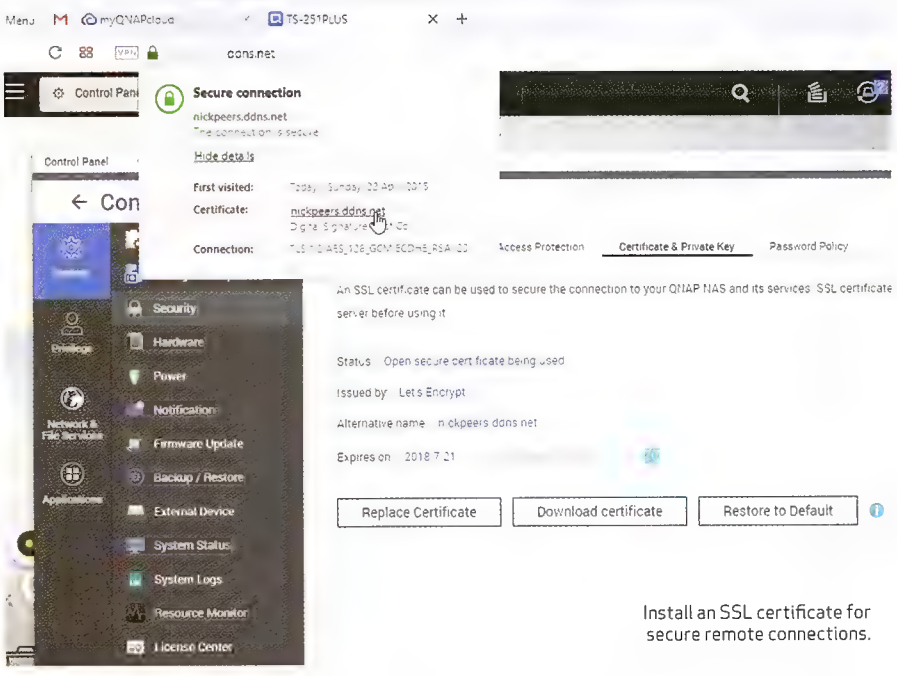
Another key consideration is how much storage you'll need – if you want to house your digital media collection alongside your cloud backups, for example, then you'll have to pay more for a larger capacity drive. But what if your needs grow? Most network drives offer USB connections to enable you to plug in regular external drives as one way to expand your storage; while others offer two or more drive bays, enabling you to grow your storage as your needs and budget allow. These models cost more and – in the case of QNAP and Synology – you'll need to purchase the hard drives to populate your network storage separately (we recommend Western Digital Red NAS drives for this purpose), which will, of course, push up the cost further, but may be worth it in the long run.

## SECURITY CONSIDERATIONS

If you plan to access your data when away from home, you'll also need to find a way to securely open up your NAS to the Internet without comprising the rest of your network (or even the NAS itself). Network-attached storage box manufacturers offer their own personal cloud offerings that are designed to make this as secure and convenient as possible – examples include My Cloud (Western Digital) or myQNAPcloud (QNAP). Your router should detect traffic requesting access to the cloud device and route it correctly – if it doesn't, check to see whether Universal Plug 'n' Play (UPNP) is enabled; if not, you'll need to consult the NAS's documentation to manually open the correct ports for internet access. Meanwhile, the connection to your NAS should be secure and encrypted – verify this by checking whether the web address has a green padlock or is prefixed by 'https://'.

If you host your own cloud storage solution, such as ownCloud, you'll need to consult its documentation to open it up for access outside your home network. You'll also need to set up a dynamic DNS address paired with an SSL certificate pointing to that address to enable you to connect to your server over the Internet. Free options can be found at **www.noip.com/free** and **letsencrypt.org** respectively, but check that your NAS supports both services – QNAP does, but if yours doesn't you'll need to see what it does support and possibly be prepared to pay for the privilege.

You should be able to link your DDNS address through your NAS settings, or try your router instead. SSL certificates are usually applied through the NAS – in the case of QNAP models, go to 'Control Panel > Security > Certificate & Private Key' to apply for a free Let's Encrypt certificate. Note: it will expire every three months, so be sure to check back 10 days before expiry to renew it. ■




Install an SSL certificate for secure remote connections.

## Three NAS drives to consider

**1 WD MY CLOUD HOME**
**FROM $229 (2TB)**
This entry-level option offers either a single non-replaceable drive or two replaceable drives depending on your model. The USB ports on the back only work to take data from other drives, sadly, but a small collection of supplied apps provide some flexibility.

**2 QNAP TS-228A**
**FROM $229 (DISKLESS)**
QNAP's entry-level two-bay drive lets you experiment with its wide array of apps without breaking the bank. Crucially, its app store enables you to select ownCloud as an alternative to QNAP's own proprietary personal cloud storage solution if you prefer.

**3 ASUSTOR AS3102T**
**FROM $359 (DISKLESS)**
This two-bay drive is powered by an Intel dual-core processor and 2GB RAM, making it particularly suitable for those who want to do more with their network drive than simply use it as a substitute for cloud backup. It's particularly handy for streaming media.

# Back up your Mac with Time Machine

## How to back up all of your important data and restore it when you need to.

**The Time Machine app on your Mac is there for peace of mind. It provides a handy means of backing up all of your important data without you having to lift a finger.**

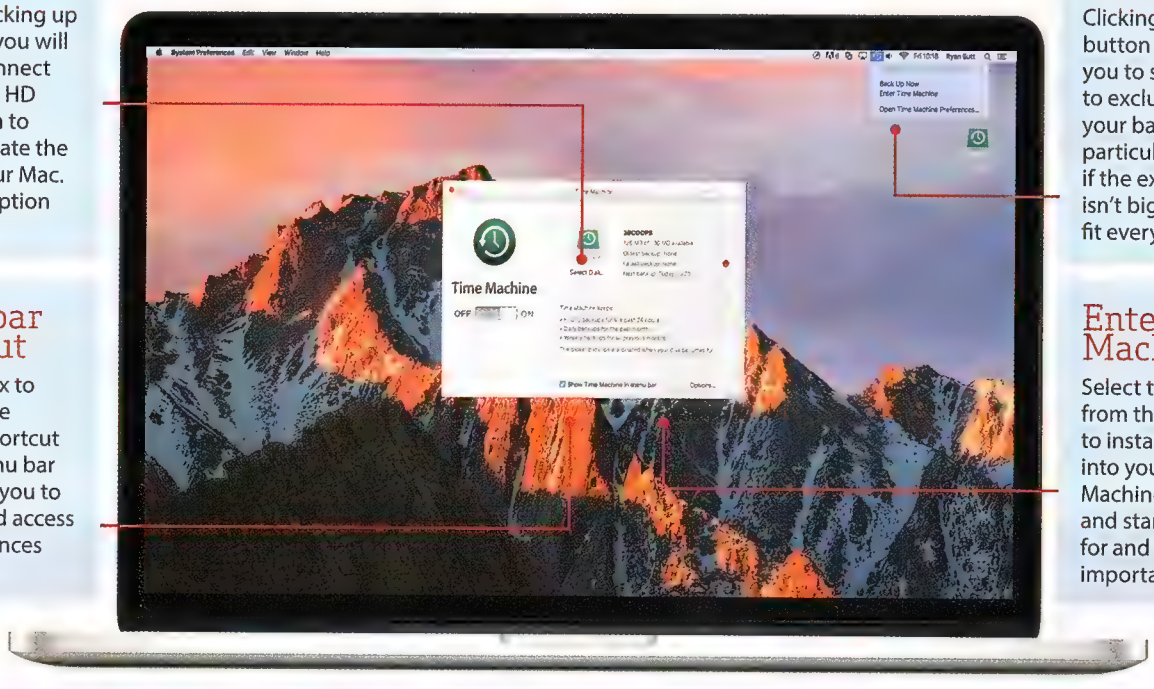
It then allows you to delve into your backups and pick individual files to restore in the event of them getting lost or corrupted. Setting up your Time Machine is quick and easy, just go to System Preferences, click on the Time Machine pane and then connect an external HD to your Mac. Once you have chosen your disk, the first backup will occur almost immediately (and then every hour afterwards) and that really is all the setup that's required. If you find that you need to restore a backed-up file, then you can enter your Time Machine's interface, scroll back through the timeline and then pluck individual files out to replace lost or corrupted versions on your Mac. It's a useful service that we advise everyone to consider in order to protect your important data. Read on to find out more.

### Selecting disks

To start backing up your data, you will need to connect an external HD big enough to accommodate the data on your Mac. Click that option to select it.

### Menu bar shortcut

Tick this box to place a Time Machine shortcut in your menu bar that allows you to back up and access this Preferences pane.




### Time Machine Preferences

Clicking on this button will allow you to select items to exclude from your backup. This is particularly handy if the external drive isn't big enough to fit everything onto.

### Enter Time Machine

Select this option from the menu bar to instantly jump into your Time Machine backups and start looking for and restoring important files.

### Restoring files from a backup

#### Delve into your Time Machine

If you find that you need to restore specific files from a Time Machine backup, then either click on the menu bar item and choose the 'Enter Time Machine' option, or launch the Time Machine app from your Applications folder. Once in, use the timeline on the edge of the screen to see the files in your backup. Select a file and press the Space Bar to preview the contents and ensure it is the one you want, then click Restore to restore the selected file. It really is very simple and incredibly useful. You'll never lose a file again.

## Set up Time Machine

Get started by going to the System Preferences pane.

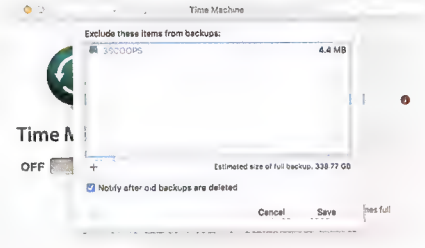
You can start setting up Time Machine by going to System Preferences on your Mac and launching the Time Machine pane. There are three main things you can do here: turn the Time Machine feature on, select a backup disk to use and tick the option to 'Show Time Machine' in menu bar. This will allow you to enter your Time Machine backups and access this Preferences pane instantly. Connect an external HD, click Select Disk and select it to begin backing up right away.

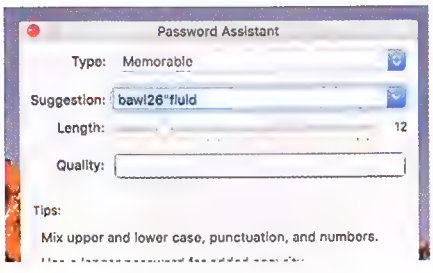
Time Machine
Time Machine
OFF ON
3SCOOPS
126 MB of 130 MB available
Oldest backup: None
Latest backup: None
Next backup: 102 seconds...
Select Disk...
Time Machine keeps:
• Hourly backups for the past 24 hours
• Daily backups for the past month
• Weekly backups for all previous months
The oldest backups are deleted when your disk becomes full.
Show Time Machine in menu bar
Options...

## Exclude items from backup

Select files and apps to leave off the backup.

As backing up the entire contents of your machine will undoubtedly take up a phenomenal amount of space on your external HD, you may wish to exclude certain items from the backups. To do this, go to the Time Machine System Preferences pane and then click on the Options button. This will bring up a window of items to exclude, so click on the + icon and then navigate to the item(s) you don't wish to back up. Hit Save when done. This should give you some added peace of mind.




## Encrypt your backups

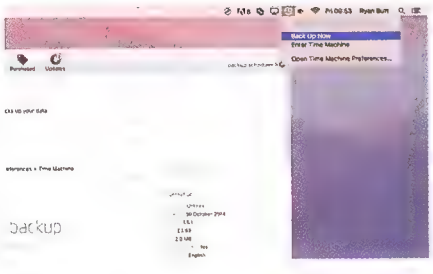
Add extra security to your backups.

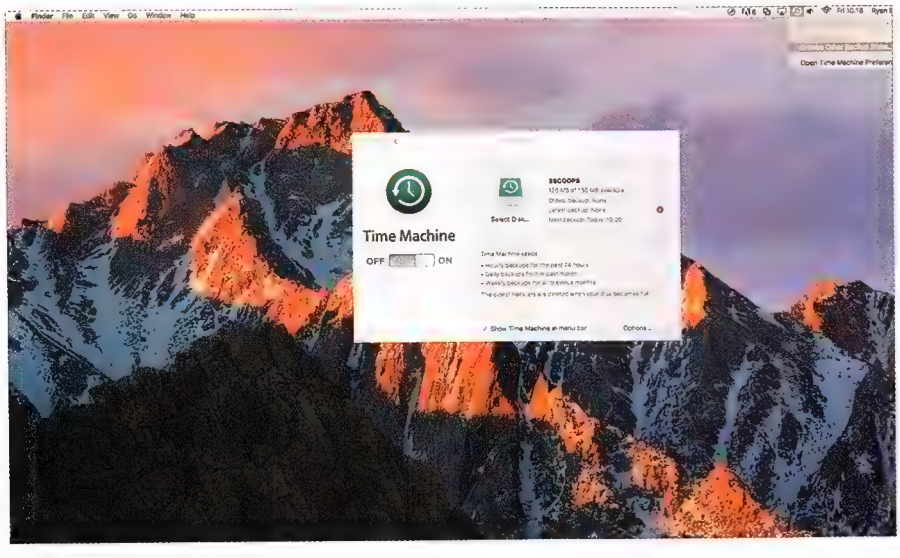
When selecting a disk to use for your backups, you can also tick the 'Encrypt Backups' box to add extra layers of security. When you tick the box and click on 'Use Disk', you will be prompted to enter and verify a backup password. Click on the key icon and the Password Assistant will be launched, which will help you gauge the strength of the password you intend to use. While this feature is optional, if you're working in an office with lots of other users, it could be useful.

## Schedule your backups

Apply flexibility to your backup schedule.

Time Machine backups run every hour and there are no built-in options to change this. However, you can give them a kickstart by running them manually by clicking on the Time Machine menu bar item and choosing the 'Back Up Now' option. Alternatively, go to the App Store and consider purchasing apps like Backup Scheduler for Time Machine, which would provide a lot more flexibility and allow you to determine exactly when your important data gets backed up.






## Verify your backups

Ensure that a backup is successful.

Time Machine will notify you whenever it can't complete a backup. To ensure that a backup is good, you can hold down the Alt key, click on the Time Machine menu bar item and then choose the Verify Backups option. To make the backup process more reliable, you should consider selecting multiple disks for Time Machine, which you can do in the Time Machine System Preferences pane. Hold the Alt key and choose the 'Browse Other Backup Disks' option from the menu bar item to select your alternate disks. ■

# Terabyte showdown

Whether you need storage on the go, space on your desktop for documents or room for your games, Joel Burgess has dug up the best external hard drives for just about everyone.

**While the flash storage space is undoubtedly growing, external hard disk drives (HDDs) still offer significantly more space at a much lower price.**

There won't be much HDDs can do to try to mitigate the speed advantage of SSDs (the physical parameters of the spinning platters provide a pretty hard upper limit on transfer rates), but portable drive capacities are continuing to grow. Bigger portable drives, greater desktop drive capacities and a series of games-console branded HDDs tend to dominate store shelves more than wireless drives.

Despite being front and centre at retail, there hasn't been much innovation in the space over the last year (the game-specific drives are literally just new packaging), but prices did drop considerably. What you pay for portable and desktop HDDs can vary considerably from vendor to vendor, so while we kept the listed costs pegged as low as we could find from the major local retailers, as usual, it's worth shopping around as much as possible.

Below are our picks for the best USB hard drives, which we've chosen across a range of five handy sub-categories.

FROM $89 | WWW.WDC.COM

BEST VALUE

## WD My Passport

### Travel to a more valuable storage solution.

The portable storage space is a clear example of economies of scale, which demand that, when you buy more of something, the cost per unit falls. For most people, a terabyte or two is enough, even if it comes at a premium. While generally you're looking at paying anywhere between $90 and $110 for a 1TB portable drive, WD's My Passport sneaks in at $89. You can save $10–20 on bare-bones drives that generally hold up reasonable read and write speeds, but you'd miss out on the security and backup software that the My Passport comes bundled with. WD released its revamped My Passport drives in 2017 with a Maxibon-like, half-smooth/half-textured plastic exterior, which is so square you can securely stack the 117g bricks on top of one another without worrying if they'll topple. With a sustained read speed of 114.5 MB/s and write speeds of 110.1MB/s, the new My Passport is in the middle of the road when it comes to transfer rates, but it's respectable for the budget end of the HDD market.

### Verdict

A good all-round drive that comes in at a very fair price.

4TB, $198; 5TB, $259
WWW.SEAGATE.COM/AU

BEST HIGH-CAPACITY

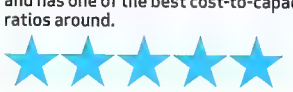
## Seagate Backup Plus Portable

### Mass storage on the go.

Most gaming laptops come with 1TB of HDD storage while professional ultrabooks often end up with significantly less than that, so 5TB is a lot of storage space. In fact, this is the largest capacity portable drive available to consumers, apart from maybe the Seagate USB-C powered Innov8 drive. This relatively compact 2cm thick drive fits neatly into a slightly frumpy plastic casing. While it's not the sleekest looking device, its strengths in other areas more than make up for the squarish design. The Backup Plus Portable's high data density means this 5TB unit was able to achieve a 10% speed boost over comparable drives we've tested in the past. The device's sequential read and write speeds were a high 143MB/s and 134MB/s, respectively, using CrystalDiskMark 3.0.4. Not only is it unusually generous, it's also reasonably priced with the 4TB going for as little as $215 online and the 5TB model just a little more at $277 from Kogan.

### Verdict

This heavyweight portable is fast, spacious and has one of the best cost-to-capacity ratios around.



1TB, $99; 2TB, $138 | WWW.SEAGATE.COM

BEST ULTRAPORTABLE

## Seagate Backup Plus Ultra Slim

### Disappears into 'Ultra Slim' air.

Sliding in at a skinny 9.6mm, the metallic cratered exterior of the Backup Plus Ultra Slim is just half a centimetre thicker than the company's inside-out portable drive, the Seagate Seven, which is so thin you can see the shape of the drive itself. This makes the Backup Plus Ultra Slim as compact as HDDs come but without the added cost of R&D for a unique housing.

With sequential read and write speeds around the 129MB/s mark on CrystalDiskMark benchmarks, Seagate's mainstream ultra-portable drive is also quicker than most of the drives we've tested by about 15MB/s. You could argue that even the slimmest portable HDD has twice the footprint of portable SSDs, but at $109 for 1TB of space, the Seagate Backup Plus Ultra Slim is around the sixth the price of a similarly sized portable SSD. When you pitch it that way, the slightly larger 159g, 1.21cm-thick Backup Plus Slim will be more than compact enough for most.

**Verdict**

An extremely compact portable HDD with a price that hard to pass on.

★★★★½

2TB $149 | WWW.SEAGATE.COM

BEST OUTDOOR DRIVE

## Seagate DJI Fly Drive

### Pretty fly for a hard drive.

In 2017, Seagate partnered with drone manufacturer DJI to develop a portable HDD with a feature set specifically tailored for use with drones. While the case is very similar to Seagate's Backup Plus Portable range (left), it adds a rubber bumper to protect it a little more than your average drive from bumps and drops. We've generally found that the console gaming drives were just regular external drives with new skins, but the DJI Fly Drive actually seems to add useful features. Most prominent of these is the microSD card slot that's built directly into the drive. This is an excellent addition, benefiting any modern laptop without the microSD card slot. This is complimented by a USB Type-C that will allow you to plug in to the most compact premium devices on the go. The sequential read and write speeds of the DJI Fly Drive are at the high end of hard disk drives, landing just shy of 130MB/s each way, to round out a nicely tailored, portable drive for outdoor photography.

**Verdict**

A well balanced rugged drive that adds SD card compatibility.

★★★★☆

FROM $189 | WWW.SEAGATE.COM

BEST DESKTOP

## Seagate Backup Plus Hub

### Hubba Hub-ba! A highly desirable option.

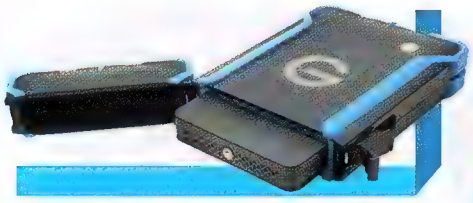
Desktop external storage hasn't seen the same dramatic capacity increases as portable drives in past years, and though 8,000GB of disk space is in no way an insignificant amount, it's not quite revolutionary for an external desktop-bound drive. That said, the 8TB Backup Plus Hub excels in terms of value, speed, size and features.

On the beveled front edge of this drive's plastic case are a pair of USB 3.0 ports that double as a charging point for your phone or tablet or for you to plug in portable USB drives to backbup to the Hub's own internal storage. There's naturally a bit of a speed boost associated with bigger 'desktop' external drives (at least compared to their portable cousins) and the Backup Plus Hub's sequential read and write speeds of 198MB/s and 188MB/s are testament to that. At $374, the 8TB drive works out to be exceptionally good value at $47-ish per terabyte and with the additional hub perks this is one highly-desirable digital storehouse.

**Verdict**

The best value large capacity desktop drive with a pair of charging ports up its sleeve.

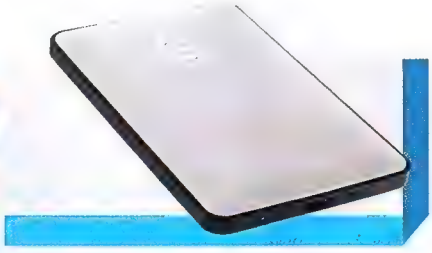
★★★★★



## G-Technology G-Drive ev ATC

**1TB, $319.95 | WWW.G-TECHNOLOGY.COM**

The ev ATC range is the fastest 'rugged' drive we've seen and it's unique waterproof casing includes a conveniently inbuilt thunderbolt cable. Keep in mind, G-Drive's range isn't compatible with Windows Devices out of the box.



## G-Technology G-Drive Mobile USB-C

**1TB, $129.95 | WWW.G-TECHNOLOGY.COM**

The speeds of external drives are limited by the physical speeds of spinning disks, so the USB Type-C only adds compatibility. The actual disk drive in this particular unit is quicker than most, though, with read and write scores around the 130MB/s mark.

## LaCie Rugged USB-C

**1TB, $169.95 | WWW.LACIE.COM**

If you need to keep your data safe from the elements, there are a few options available, but LaCie's Rugged USB-C is going to be one of the more reliable options with its water-, pressure- and shock-resistant case.

## Seagate Backup Plus Slim

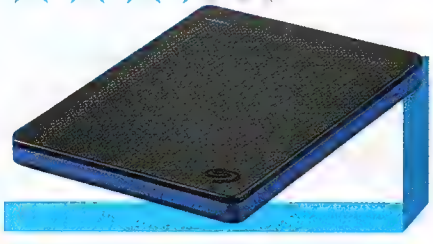
**1TB, $89 | WWW.SEAGATE.COM**

At 1.21cm thick, the Backup Plus Slim from Seagate is only a few millimeters thicker than the Backup Plus Ultra Slim. If you can live with that extra bulkiness, you'll save yourself $10–15 opting for this unit instead.

## Seagate Game Drive Hub

**8TB, $369 | WWW.SEAGATE.COM**

Since the Game Drive Hub is just a reskinned Seagate's Backup Plus Hub (the reigning champ in our desktop hard drive category), it makes sense that we like this model and its two conveniently located USB charge ports.



## Seagate Game Drive for PS4

**2TB, $149 | WWW.SEAGATE.COM**

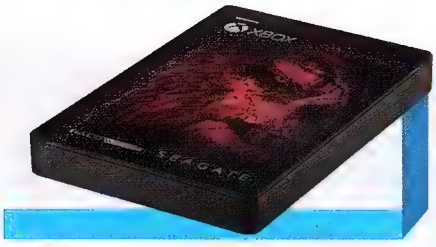
Seagate's portable hard drive for the Sony console is quite a bit slimmer than the Xbox Halo Wars Special Edition and is wrapped in a metal casing. While small, these features at least make up somewhat for the inflated price.

### EXTERNAL HARD DRIVES

| | G-TECH G-DRIVE EV ATC | G-TECH G-DRIVE MOBILE USB-C | LACIE RUGGED USB-C | SEAGATE BACKUP PLUS HUB | SEAGATE BACKUP PLUS PORTABLE | SEAGATE BACKUP PLUS SLIM | SEAGATE BACKUP PLUS ULTRA SLIM | SEAGATE DJI FLY DRIVE | SEAGATE GAME DRIVE HUB FOR XBOX | SEAGATE GAME DRIVE FOR XBOX | SEAGATE GAME DRIVE FOR PS4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SCORE | 3 | 3 | 3 | 4.5 | 5 | 4 | 4.5 | 4 | 4.5 | 3 | 3.5 |
| CATEGORY | RUGGED | TYPE-C | RUGGED | DESKTOP | CAPACITY | VALUE | ULTRA PORTABLE | DRONE | GAME | GAME | GAME |
| PRICE | $319.95 | $129.95 | 1TB, $169.95; 2TB, $229.95; 4TB, $259.95 | $189, $249, $349 | $198, $259 | 1TB, $89; 2TB, $119 | 1TB, $99; 2TB, $138 | 149 | $369 | $149, $249 | $149 $259 |
| SIZES | 1TB | 1TB | 1TB, 2TB, 4TB | 4TB, 6TB, 8TB | 4TB, 5TB | 1, 2TB | 1TB, 2TB | 2TB | 8TB | 2TB, 4TB | 2TB 4TB |
| TEST SIZE | 1TB | 1TB | 2TB | 8TB | 5TB | 2TB | 2TB | 2TB | 8TB | 2TB | 2TB |
| $/TB RATIO (BASED ON TEST SIZE) | 320 | 129.95 | 115 | 43.625 | 51.8 | 59.5 | 69 | 74.5 | 46.125 | 74.5 | 74.5 |
| DIMENSIONS (CM) | 20.4 x 15.4 x 5.21 | 12.9 x 8.2 x 1.3 | 13.5 x 8.6 x 1.9 | 19.8 x 11.8 x 4.1 | 11.5 x 7.8 x 2 | 11.3 x 7.6 x 1.21 | 11.3 x 7.6 x 0.96 | 12.2 x 8.5 x 2 | 11.8 x 4.1 x 19.8 | 11.7 x 8 x 14.8 | 11.3 x 7.6 x 1 |
| WEIGHT (G) | - | 170 | 270 | 1060 | 247 | 159 | 159 | 217 | 890 | 169 | 135 |
| INTERFACE | - | USB 3.1 | USB TYPE-C/A (THUNDERBOLT & 3.1) | USB 3.0 | USB 3.0 | USB 3.0 | USB 3.0 | USB 3.0 | USB 3.0 | USB 3.0 | USB 3.0 |
| SEQUENTIAL READ (MB/S) | 136.1 | 135.4 | 141.5 | 197.9 | 143 | 116.2 | 129 | 129.8 | 190.1 | 137.4 | 134.9 |
| SEQUENTIAL WRITE (MB/S) | 130.4 | 128 | 122.9 | 188.2 | 134.6 | 114.6 | 128.2 | 128 | 184.3 | 131.3 | 130.1 |
| 512MB READ | NA | NA | 41.24 | 55.64 | 42.23 | 39.56 | 44.69 | 46.22 | 54.01 | 45.46 | 46.46 |
| 512MB WRITE | NA | NA | 103.6 | 95.82 | 72.33 | 48.7 | 87.73 | 82.36 | 119.4 | 81.43 | 82.48 |



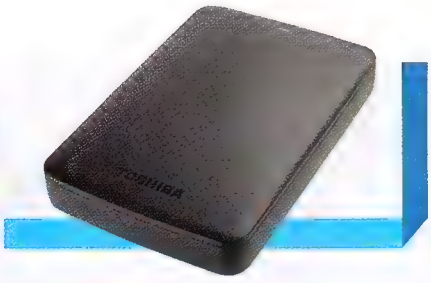
NOTE* WIFI TRANSFER OF 472.97MB FILE IN 1M10S



## Seagate Game Drive for Xbox

**2TB, $149 | WWW.SEAGATE.COM**

The specific console branding of this portable drive might get you thinking there is some reason why the Game Drive for Xbox works better with a console than a regular hard drive, but it doesn't actually add anything extra.



## Toshiba Canvio Basics

**1TB, $87 | WWW.MYTOSHIBA.COM.AU**

This drive's initial pricing was excellent, but it didn't come down as it aged, allowing other HDDs that come with backup and security software to overtake it in terms of value.

## Toshiba Canvio Premium

**1TB, $109 | WWW.MYTOSHIBA.COM.AU**

A fast, premium-looking drive at a reasonable price that sweetens the deal with a metal case, a black velvety bag and a USB A-to-C adapter. Also bundled is a HDD hardware encryption tool, NTI backup software and the Pogoplug PC app.

## WD My Book Duo

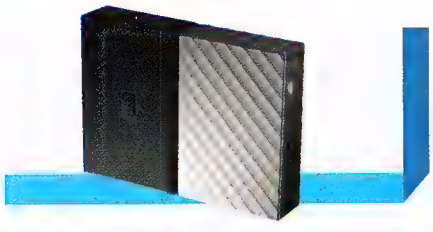
**4TB, $429 | WWW.WDC.COM**

This monster desktop drive uses two big hard disk drives in a RAID 0 configuration for over 330MB/s read speeds and write speeds of 184MB/s for a reasonable price. There is an updated model that we haven't tested but you can still get the 4TB model at a good price.

## WD My Book

**6TB, $299 | WWW.WDC.COM**

External desktop drives are hardly a melting pot for the latest innovations, but at least most attempt to have at least some point of difference. The newly coated WD My Book isn't a bad desktop drive, but it doesn't really give you any reason to buy it.



## WD My Passport Ultra

**FROM $109 | WWW.WDC.COM**

WD has played it safe by making the 4TB My Passport Ultra the largest in its latest range. The updated facade makes the Ultra series indistinguishable from the regular My Passport offering, an interesting decision since they're marginally faster and more expensive.

| | TOSHIBA CANVIO BASICS | TOSHIBA CANVIO PREMIUM | WD MY BOOK | WD MY BOOK DUO | WD MYPASSPORT | MY PASSPORT ULTRA | G-TECH G-DRIVE (WITH THUNDERBOLT) | G-TECH G-DRIVE MOBILE | LACIE PORCHE DESIGN PORTABLE DRIVE | TOSHIBA CANVIO CONNECT II | WD MY PASSPORT WIRELESS PRO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SCORE | 3 | 3 | 4 | 3.5 | 4.5 | 4 | 2 | 2/5 | 2.5 | 3.5 | 4 |
| CATEGORY | VALUE | ULTRA PORTABLE | DESKTOP | DESKTOP | VALUE | VALUE / CAPICITY | DESKTOP | VALUE | TYPE-C | VALUE | WIRELESS |
| PRICE | 1TB, $87; 2TB, $115 | 1TB, $109; 2TB, $156 | $179, $199, $299, $399 | 4TB, $429 | $85, $118, $218 | 1TB, $109; 2TB, $153; 3TB, $169; 4TB $199 | 4TB, $619.95; 6TB, $699.95; 8TB, $980; 10TB, $1,220 | 500GB, $129.95; 1TB, $149.95 | 1TB, $93.98; 2TB,$143.98; 4TB, $170.99 | $88, $129, $168 | $289, $349, $399, $449 |
| SIZES | 500GB, 1TB, 2TB | 1TB, 2TB | 3TB, 4TB, 6TB, 8TB | 4TB, 8TB, 12TB, 16TB, 20TB | 1TB, 2TB, 4TB | 1TB, 2TB, 3TB, 4TB | 4TB, 6TB, 8TB, 10TB | 500GB, 1TB | 1TB, 2TB, 4TB | 1TB, 2TB, 3TB | 1TB, 2TB, 3TB, 4TB |
| TEST SIZE | 2TB | 2TB | 6TB | 4TB | 4TB | 4TB | 4TB | 1TB | 4TB | 2TB | 3TB |
| $/TB RATIO (BASED ON TEST SIZE) | 57.5 | 78 | 49.8 | 107.25 | 54.5 | 49.7 | 154.4 | 149.95 | 42.7 | 64.5 | 133 |
| DIMENSIONS (CM) | 11.9 x 7.9 x 1.5 | 11 x 2.2 x 8.2 | 17.1 x 13.9 x 4.9 | 15.7 x 9.9 x 16.5 | 11 x 2.1 x 8.1 | 11 x 8.2 x 1.4/2.2 | 23.5 x 12.5 x 4.5 | 12.7 x 8.3 x 1.8 | 12.8 x 8.4 x 1 | 10.9 x 7.8 x 1.4 | 12.6 x 12.6 x 2.3 |
| WEIGHT (G) | 210 | 250 | 1,050 | 2,300 | 250 | 140/250 | 1,351 | 410 | 190 | 149 | 450 |
| INTERFACE | - | USB 3.0 (TYPE-C ADAPTER) | USB 3.0 | - | USB 3.0 | USB 3.0 | THUNDERBOLT/USB 3.0 | USB 3.0/ THUNDERBOLT | USB 3.0, 3.1 | - | 802.11AC/ MICRO + USB 3.0 |
| SEQUENTIAL READ (MB/S) | 116.4 | 119.8 | 168.4 | 331.7 | 114.5 | 134.2 | 139 | 104.7 | 137.7 | 115.9 | 118.1 |
| SEQUENTIAL WRITE (MB/S) | 114.2 | 118.9 | 167 | 184.2 | 110.1 | 127.77 | 124 | 102.3 | 134 | 115.5 | 115.1 |
| 512MB READ | 42.21 | 41.28 | 52.26 | 53.68 | 42.31 | 44.91 | 40.7 | NA | 45.21 | 41.15 | 42.81 |
| 512MB WRITE | 47.27 | 50.28 | 111.4 | 34.22 | 111.8 | 128 | 94.1 | NA | 98.53 | 49.32 | 77.56 |

# Fast external storage options compared

## Portable SSDs have become faster and more affordable over the past couple of years. Joel Burgess finds out if they're still too flashy for your average consumer.

**Prior to Samsung releasing its T1 external hard drive, portable solid state drives (SSDs) were a little expensive to be a particularly appealing alternative to portable external hard disk drives (HDDs).**

But it's been a few years since then and the portable SSD market has matured into an appealing category, attracting the efforts of big hard drive players like Western Digital and LaCie, and even sporting a few second or third generation drives from SanDisk and Samsung. The latest external SSDs benefit from some hardware innovations that give sequential read and write speeds of 400–500MB/s – some 100–200MB/s faster than the first generation fast flash drives.

That's an increase of roughly 25%! While this isn't quite enough to make RAIDed fast drives obsolete just yet, the traditional, spinning-plate 250MB/s dual HDDs will only be around for another few years at most. What's perhaps even better for consumers, though, is that this competition is driving prices down, making fast storage something that anyone can have.

### HOW WE TESTED

The External SSDs and fast USB flash drives were tested in both CrystalDiskMark 5.1.2 and the earlier CrystalDIskMark 3.0.4 in 64-bit mode with five repeats and 500MB file sizes. All benchmarks were performed on a Surface Pro 4 using a USB 3.0 interface.

**EXTERNAL SSDS**

| | HYPER X PREDATOR | LACIE RUGGED THUNDERBOLT USB-C | SAMSUNG T5 | SANDISK EXTREME 500 | SANDISK EXTREME PRO (256GB) | WD MY PASSPORT SSD |
|---|---|---|---|---|---|---|
| PRICE | 64GB, $78; 128GB, $129; 256GB, $195; 512GB, $389 | 500GB, $449; 1TB, $799 | 250GB, $179; 500GB, $249; 1TB, $509; 2TB, $1059 | 128GB, $119; 240GB, $149; 480GB, $ 318 | 128GB, $112; 256GB, $219 | 256GB, $159; 512GB, $239, 1TB, $459; 2TB, $949 |
| TEST SIZE | 128GB | 500GB | 500GB | 240GB | 128GB | 512GB |
| $/TB (BASED ON TEST SIZE) | 1032 | 898 | 498 | 596 | 896 | 478 |
| DIMENSIONS (CM) | 7.6 x 2.3 x 1.2 | 14 x 8.9 x 2.5 | 7.4 x 5.7 x 1.1 | 7.6 x 7.6 x 1.1 | 1.1 x 2.1 x 7.1 | 9 x 4.5 x 1 |
| WEIGHT (G) | 20 | 400 | 51 | 79 | 16 | 40 |
| INTERFACE | USB 3.1 TYPE-A | USB 3.1 TYPE A AND C | USB 3.1 TYPE C TO A AND C TO C CABLES | USB 3.0 MICRO-B | USB 3.1 | USB 3.1 TYPE C TO A AND C TO C CABLES |
| SEQ. Q32T1 (R) | 264.5 | 533.1 | 437 | 335 | 326.2 | 390.1 |
| SEQ. Q32T1 (W) | 244.6 | 484.7 | 444.3 | 191.4 | 306.5 | 385.4 |
| 4K Q32T1 (R) | 7.046 | 115 | 164.6 | 20.83 | 12.36 | 24.18 |
| 4K Q32T1 (W) | 0.933 | 113.1 | 164.4 | 3.77 | 9.242 | 27.73 |

**FROM $179 | WWW.SAMSUNG.COM/AU**

## Samsung T5 Portable SSD

### High five for Samsung's new solid state drive.

Samsung's T1 and T3 drives were some of the first portable SSDs to get the company's V NAND layering tech, pushing read and write speeds above the 200–300MB/s threshold of traditional flash based storage. While a lot of the market has now caught up and LaCie's new Rugged SSD is actually even faster, the T5 is still well above average and isn't as expensive as the top player. While the 437 and 444MB/s sequential Q32T1 read and write speeds are still impressive, the T5 is also exceptionally compact, lining up with the footprint of WD's SSD offering. The card-sized unit actually manages to pass the 2m shockproof drop test, at least under controlled conditions in Samsung's lab, competing with some of the durability features of LaCie's rugged unit. The T5 is barely 10% faster than the T3, so if you can buy the older model at a discount, do so. That said, Samsung's latest SSD is still competitive when it comes to value, with the 500GB T5 model landing just above WD's 512GB SSD by about $10.

### Verdict

**The fastest and best value portable SSDs available.**

FROM $159 | WWW.WDC.COM

## WD My Passport SSD

### Your ticket to speedier storage.

WD's long since been a dominant player in the portable hard drive space. Although it's late to the party with its My Passport SSD, this flash drive comes in strong to create genuine competition at the top of the market. It isn't quite as fast as Samsung's T5 getting read and write speeds of 390.1 and 385.4 MB/s in the SSD-oriented sequential Q32T1 speed tests, but the My Passport is only about 10% slower, and is actually faster than the T5 in the older non-queued sequential speed tests. In real-world use, the difference would be unnoticeable. The two are also about the same size; the My Passport is slightly narrower and longer than the T5 and weighs a mere 40g. The My Passport SSD borrows the dual textured exterior of the larger My Passport range and offers both USB 3.1 Type-A and C cables to connect to a range of modern devices.
On average street prices are $20 more for the WD My Passport SSD, but it's as close a competitor to Samsung's T5 as we've seen.

**Verdict**

This fast portable SSD is both compact and good value.

★★★★½

FROM $78 | WWW.HYPERXGAMING.COM

## HyperX Savage

### A slick and speedy drive that could do with a discount.

The metallic red X shaped frame wrapping around the HyperX Savage drive is unapologetically flashy and makes it clear that this USB is aimed at gamers. The soft black powdery plastic and the heavy metal alloy combine to give a uniquely weighty and premium feel. The Savage is a flash-based USB drive that keeps up with SSDs in most of the general usage speed tests.
The HyperX Savage uses the USB 3.1 interface through a male Type-A connection, and has no included adapter for USB Type-C. The Savage pushed sequential reads at a respectable 312MB/s and could write sequentially at 211MB/s, which isn't particularly fast but not significantly slower than the other thumb drive here either. At just 128GB, it is one of the smaller capacities on offer and it's a little pricey when you consider you can get some of the larger capacity 256GB drives here for a similar price or comparable drives from Kogan for half the price.

**Verdict**

This USB flash drive is fast, loud and expensive.

★★★☆☆

**WHAT TO LOOK FOR**

What to look for when purchasing a portable SSD...

#### Interface

All of the drives tested here are either USB 3.0 or 3.1, but there is no reason Thunderbolt adaptors couldn't work equally as well for devices aimed at Mac users. Be careful not to buy anything with USB 2.0, as it won't be able to transfer faster than 60MB/s (practical transfers of around 40MB/s).

#### Size

SSDs and flash USB drives still have distinct form factors as a matter of habit. Decide if you want a compact portable hard drive shape, or you would prefer to plug in an oversized USB flash drive.

#### Connection

This is generally related to the interface but the two main connections to be aware of are USB Type-A (the most common USB connection) and USB Type-C. You'll need to check it'll be compatible with the ports in the devices you wish to use it with.

#### SSD vs Flash USB

The difference here is largely semantic and historical. SSDs were originally made from DRAM memory chips (what your computer uses as memory), but these days any affordable SSD will be made from NAND Flash technology.

FROM $112 | WWW.SANDISK.COM.AU

## SanDisk Extreme Pro USB 3.1 SSD

### USB stick it to the man.

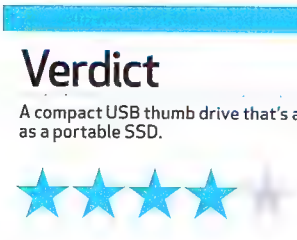
While Samsung seems to still have the edge in the portable SSD market, the SanDisk Extreme Pro USB 3.1 Solid State Flash Drive isn't a bad alternative if you want to stick to the stick form-factor. By calling it a solid state flash drive, SanDisk wants to convey that, even though it takes the form factor of a USB flash drive, it actually has the speeds of a larger SSD.

And SanDisk isn't lying: the drive pulls sequential Q32T1 read and write speeds of 311.4 and 287.7MB/s in CrystalDiskMark 5, a score that is well above any USB flash drive we've tested and beats the SanDisk Extreme 500 by at least 10% across all speed tests.

While it's hardly novel, the retractable USB stick form factor is convenient if you want to carry it in your pocket, and comes with a plastic loop to attach it to your keychain. 256GB is a reasonable capacity and the price isn't over the top, but if you don't have to have your SSD attached to your keys, you can get about 30% faster speeds from Samsung's T5.

**Verdict**

A compact USB thumb drive that's as fast as a portable SSD.



FROM $119 | WWW.SANDISK.COM.AU

## SanDisk Extreme 500

### A solid state diamond in the rough.

We gave the SanDisk Extreme 500 a score of 4.5 back in 2016 (issue 434, page 40), but its slower read and write speeds drag it down against newer offerings. The flat, diamond-shaped SanDisk Extreme 500 might have been overtaken by a slew of portable SSDs, but its still faster than any dual-HDD drive we've seen and far more compact. It's also still rather thin compared to other portable SSDs, measuring a little over a centimeter thick. SanDisk was one of the first to market the shock-resistant characteristic inherent in SSDs by pitching the Extreme 500 as an ultra portable rugged drive.

This pocket-sized portable drive performs in line with what should be expected from real-world tests of fast flash drives recording sequential read speeds of 335MB/s and write speeds of 283.6MB/s. We found the write speeds dropped to around the 200MB/s mark using the modern Q32T1 sequential speed tests, and the drive hasn't dropped in price at all since launch.

**Verdict**

A slightly older offering that's still speedy and comes at a reasonable price.

FROM $449 | WWW.LACIE.COM

## LaCie Rugged Thunderbolt USB-C

### Taking tech into the wild.

LaCie's rugged range has been around for a while, and although you've always paid a premium for its Mac-focused portable drives, the company's new 500GB SSD – the Rugged Thunderbolt USB-C – is even more expensive.

At close to double the price of Samsung's 500GB T5 portable SSD, it's a long way from a bargain, but this tough portable storage unit is also pretty bulky when you line it up next to the competition. Weighing in at 400 grams, it's almost eight times the mass of the T5, more than twice as thick and has close to double the footprint.

This additional bulk does afford it extra durability, bundling in a 2m drop resistance, IP54 splash resistance and a 1,000kg pressure durability to make it a good drive for people who need to carry it in unpredictable circumstances. It also happens to be the fastest SSD we have on record here at APC, getting Sequential Q32T1 read speeds of 533.1MB/s and writes at 484.7MB/s. ■

**Verdict**

A rugged and super fast portable SSD that will do some damage to your bank account.

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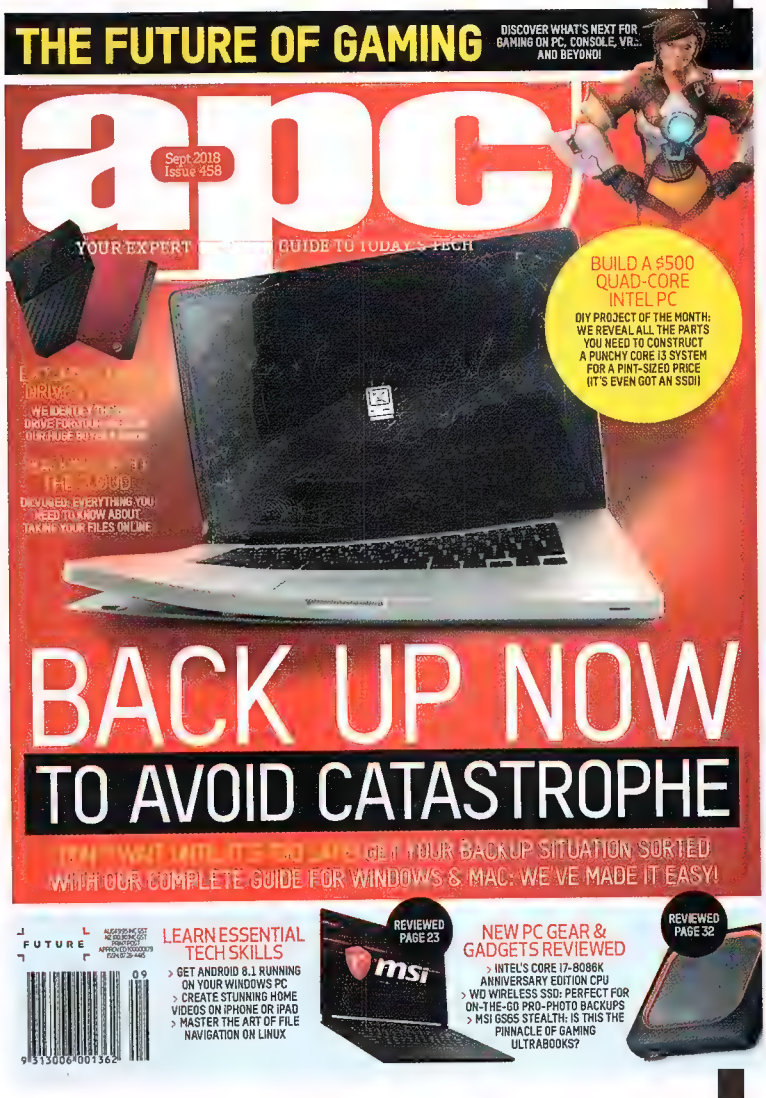
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## THE EXCITING TRENDS, TECH AND DEVELOPMENTS WE'LL BE ENJOYING FOR THE NEXT 15 YEARS OF GAMING.

One of the things that drives our love of games is that it's an ever-evolving medium. The industry just refuses to stand still or keep playing within familiar boundaries. With each passing year, we see tech companies and game makers coming up with new concepts, whether individually or in partnership, that send the collective creativity of the rest of the industry spinning off in new directions. There's always a new paradigm-changing event around the corner.

So as we reflect on gaming's past with the launch of our new monthly gaming retrospective (see page 112), we thought it made sense to cast our minds forwards to what we might expect to see in the years to come. Where is the games industry going, how tied is it to the trends or rhythms of the past, and what new ideas are simmering beneath the surface that could change the way we play going forwards? We'll explore it all in the following pages with the help of industry experts.

# THE FUTURE IS IN NEW HARDWARE

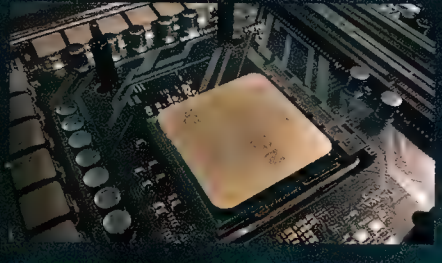
"Innovation in hardware has always influenced and even shaped how games are played in the future," games industry veteran and CEO and co-founder of Terra Virtua Gary Bracey tells us. "Whenever we see a significant development in gaming hardware, we also see a notable transformation in gaming software – both in terms of gameplay and visuals."

Historically, this has tended to feel like the norm. Each new console hardware generation or each new significant leap forward in PC performance opens the door to greater processing power, and creators devise innovative new ways to exploit that potential, coming up with new ideas in the process. Could *Portal* have existed without the processing power of modern machines to create its dimensional gateway mechanics? Could *Minecraft* have existed without the seeding and server technology running its online content?

But it may not be so much about allowing for new ideas as it is about opening up the technology to realise ideas that simply couldn't be fully achieved before. "Advances in technology have always enabled us as developers to more fully realise our vision," is Jeff Kaplan's take as game director of *Overwatch* and vice-president at Blizzard. "As hardware continues to evolve, new doors will be open to us to revisit ideas and pioneer new territory."

Which is in part why we are always hungering for new hardware, hoping to see how it can open up the imaginations of game makers. "New hardware opens up enormous creative possibilities, and I truly believe VR presents a sea-change in games, as it offers an entirely new way to interact, particularly regarding multiplayer," adds Bracey. "In fact, I'd go so far as to say it represents the most disruptive possibilities since videogames first came onto the market. This is one reason why I'm so excited about Terra Virtua, as it offers a platform for such creativity to flourish and become mainstream."

So where is hardware heading next and what could it inspire? We'll take a closer look at VR in a moment, but let's look at the big manufacturers first.



## STREAMING FOR ALL

Microsoft has taken great strides with its Game Pass program, and deciding to make all of its first-party exclusives available from day one on its subscription service is a bold move that's going to grab attention. We fully expect that Sony will look to follow suit, if not now then at least in time for the launch of any PS5 machine, and we should keep an eye on Steam too.

## MORE VR SUPPORT

PlayStation has done pretty well with VR so far, even if it hasn't managed to launch a killer app that makes the technology essential. Increased processing power on a next generation of consoles, along with wireless technology, might be the two missing ingredients that make it a much more viable option. And we expect Microsoft may follow.

## PHYSICAL MEDIA WILL HOLD ON

We understand from recent appearances by Sony at conferences that it isn't moving away from physical media just yet. Why? Because it doesn't want to abandon developing markets where internet access isn't guaranteed. In these regions, having your games on discs is pretty important, so don't expect digital downloads to take over just yet.

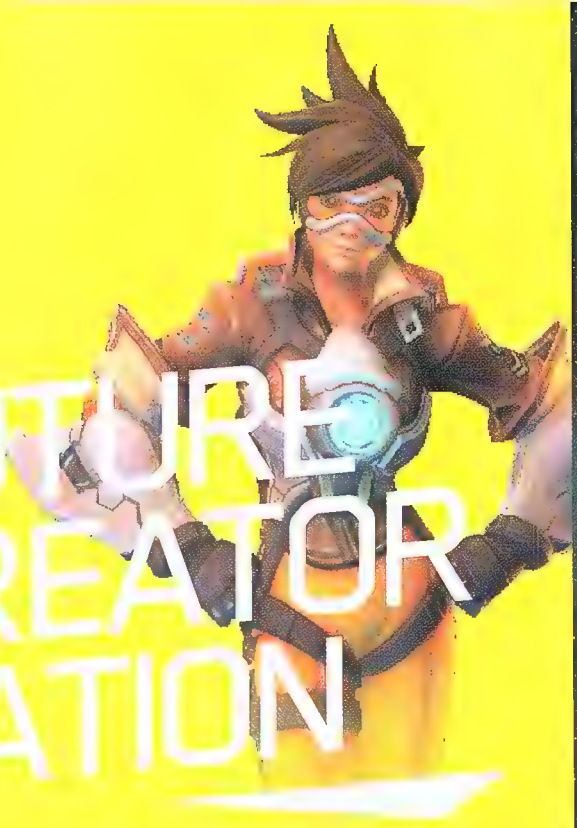
## A FUTURE FOR HANDHELDS

Nintendo doesn't seem sure what to do with the DS now the Switch offers handheld gaming with home console power, but we have to wonder if Sony and Microsoft will review their position. Is the time ripe for a new PSP? Could Xbox Portable resurface as a concept? We're not convinced. That said, we think an entry-level, kid-friendly, affordable handheld still has a role to play.

## TIERED HARDWARE OPTIONS

One of the elements we've seen from the half-step console releases of the PS4 Pro and Xbox One X is that there is now a tiered structure to how you buy a new console. You have a premium and budget option, but you can play all of the same games. While the next generation may not launch like this, we would expect similar half-step upgrades to become the norm in the years that follow.

# THE FUTURE IS IN CREATOR INNOVATION



Hardware isn't everything. What you need for real innovation is new ideas, and that can just as easily come without a big technological leap as a catalyst. David Braben OBE, for one, believes that the relationship between new ideas and tech is one we've left behind us now. "There are new media — currently VR being the most obvious one, and AR too — where specific games or play styles are enabled (or at least augmented) by the hardware, but these are not the norm," the Frontier founder and CEO tells us. "Most games are not closely tied to hardware now as they once were."

Jean-Francois Major, co-founder of Tribute Games, maker of *Mercenary Kings* and *Flinthook*, seems to agree. "The evolution of games seems to be tied to what developers can tinker with and the gamers' appetite and desire to try new things," he tells us. "Recent hardware innovation did not bring us MOBAs, battle royales, or even all those [insert boring day-to-day activity] simulators." Certainly the biggest breakout moments of gaming in recent memory have been around genre or mechanics rather than technical prowess. The hardware has been a base, but not necessarily a deciding factor when really all we're seeing is incremental improvements to performance.

"Games have continued to improve, enabled by the hardware, but I wouldn't say it is necessarily tied to hardware innovation, in the same way I don't think TV or film are tied to improvements in consumer hardware like 4K, 8K, 3D, HDR, Dolby Atmos, 7.1 etc — even though it does improve the quality, and might create some good marketing opportunities," Braben adds.

And some of the best examples we've seen of real innovation venture way outside the usual genres or mechanics we expect from games, as Major points out. "Innovation comes from these games you can't put into any genre. *Keep Talking And Nobody Explodes* comes to mind, or *My Summer Car*. (What is up with this game?!) These games are venturing into unknown territory."

## STUDIOS TO WATCH

### BLIZZARD

Nothing is done by half in the house of *Warcraft*. When the developer turned its hand to first-person shooters, it didn't follow in the footsteps of what was popular now; it chose to create something fresh in *Overwatch*, a game that continues to push boundaries and bring players together. Whatever it chooses to tackle next, you can bet it will be truly groundbreaking.

### MEDIA MOLECULE

It created the concept of Play, Create and Share with *LittleBigPlanet* and now it's taking that concept to the next level with *Dreams*. This is a game experience that's all about empowering us as players to unleash our imagination in the most accessible and egalitarian way possible. As we see the boundaries for creating games fall, *Dreams* could be a world-changer.

### NINTENDO EPD

Let's have a quick rundown of the Entertainment Planning & Development division's most recent output: *The Legend Of Zelda: Breath Of The Wild*, *Arms*, *Super Mario Odyssey* and Nintendo Labo. Seems to us that when it comes to experiences that break moulds and create new standards, you should look no further than this Nintendo group.

## GAMES AT THE CUTTING EDGE

### UPCOMING RELEASES THAT COULD SHAKE UP THE INDUSTRY

### CRACKDOWN 3

With its promise to draw on the power of Microsoft's Azure Cloud network for additional computational work, Crackdown 3 is promising possibly the most destructible online multiplayer environment ever created. Its potential for the future of cloud-connected gaming is limitless.

### ANTHEM

BioWare moving into the world of shared world shooters should be exciting to everyone. If Anthem can put its best foot forward in terms of narrative design and give us a vast world to experience, then it could well top the efforts of Bungie and Ubisoft before it. The facial animation is superb too.

### BEYOND GOOD & EVIL 2

Not content simply with bringing back a cult classic action adventure, Michel Ancel is shooting for the moon. And then he's shooting for some other stellar bodies too with a space pirate epic that will see you travel from alleyways to the stars without skipping a beat.

### STAR CITIZEN

An insane feat of crowdfunding matched only by its insane ambition, if Star Citizen can ultimately deliver the kind of interstellar exploration, trade and combat experience it has been working towards, we'll have to set a new bar for what games can achieve in the modern era.

# THE IMPORTANCE OF STREAMING

## WHY PLAYING GAMES IS BECOMING AS IMPORTANT AS MAKING THEM.

One of the biggest trends of the last five years has been the growth of live streaming play sessions on Twitch and YouTube, something that the industry would have been hard-pressed to predict, and has generally been slow to adapt to. However, being able to watch someone play a game is now a massive part of the appeal of a new game, and that's something *Overwatch*'s Jeff Kaplan thinks we should be looking to as a big area for expansion and innovation going forward.

"I think the most notable change happening in gaming right now is the influence of streaming and viewing and the generational shift towards the streaming culture," he explains. "For many, watching games is as fun as playing games. As developers start to embrace the concept of streaming and viewing, it opens the door for new and exciting design space to be explored.

"I personally believe that the next big trend in video games will be the adoption and embracement of streaming culture with games designed to maximise the experience for the streamer, viewers and other affected players."

So what would that look like? Well, building games with the spectator in mind from the beginning is an important place to start. Having non-player camera options and controls that will allow viewers to either get a different view of the action or customise their view how they see fit. As bandwidth opens up, why not have everyone be their own camera operator as they watch, focusing in on whatever they think is important? These are big additional challenges for developers.

David Braben sees this as a trend with a lot of potential. "We are likely to see the connection between players and game developers get tighter and closer, and new kinds of game emerge where players are closely involved in the whole process," he tells us. "We will see tighter integration of streamed video – similar to Twitch and YouTube Gaming today – and different kinds of interaction."

# DEVELOPMENT FOR THE MASSES

## WHO NEEDS TO KNOW HOW TO CODE ANYMORE?

Games like *LittleBigPlanet*, *Super Mario Maker* and *Roblox* have helped massively in demystifying the process of developing a game from concept to execution. These playgrounds of creativity have opened up possibilities for us as players to really make and share something that wouldn't have been a possibility for us before without a fair amount of coding and programming knowledge.

"With the likes of *Minecraft* and *Roblox*, we've seen the innovative thinking that can be produced when you put easy-to-use tools in the hands of regular gamers," says Gary Bracey of Terra Virtua. "Once you eliminate the barriers to entry so people no longer have to depend on programming knowledge or graphic creation to build a game, then you can really tap into the imagination of people who can more easily bring their ideas to life."

That's now led us to new game development tools that are easy to understand and simplified for inexperienced game makers to get into. But that's something that may only expand further in the coming years.

"I strongly believe the tools we use to make games and access to game assets will get easier to use and integrate," says Tribute Games' Jean-Francois Major. "Where making games used to be about technical feats, the emphasis will hard switch to the creative side."

Things like RPG Maker and GameMaker Studio offer even greater levels of depth to the creation process for those of us with much more limited expertise than your average developer, but could it go even further? That's something Bracey is now exploring.

"In partnership with the Unreal Engine, we are developing something called Terra Forma, which will give access to games creation to everyone, based on the most powerful 3D engine in the world," he reveals. "A suite of simple but powerful tools, which will allow everyone the means to bring their imagination to life within our platform."

# POWER TO THE PEOPLE

## GREAT EXAMPLES OF EASY-TO-USE DEVELOPMENT TOOLS

### TWINE

We really do love Twine for bits of interactive storytelling. It's a great way of understanding how narrative choices can be interwoven to create much more in-depth and compelling stories. And it is still used by really experienced and celebrated game makers. Take *The Temple Of No* by Crows Crows Crows, for instance. A very funny and engaging use of the tools Twine offers.

### GAMEMAKER STUDIO 2

Soon to be launching its Switch support, GameMaker Studio asks you for a little more knowledge of how to make a game, but still not as much as if you were jumping into an engine blind. The tools here will allow you to make a massive amount of highly personalised content. The big examples here remains games like *Hyper Light Drifter* and *Death's Gambit*.

# IS VR THE FUTURE OF GAMING?

IT'S HAD A STRONG OPENING, BUT CAN IT SHORE UP ITS POSITION AS THE FRONTLINE OF INNOVATION?

"While VR is an exciting platform that offers the potential for more immersive experiences, we're still some way off it being the radical change that many people have suggested it would be over the past couple of years," says Creative Assembly technical art director Jodie Azhar, and we have to agree. While we've enjoyed a lot of the output on PSVR, HTC Vive and Oculus Rift in particular, nothing in the VR space has struck us as truly essential just yet. But change could be coming.

"I believe immersive realities generally will turn the existing traditions of interactive entertainment on its head," insists Terra Virtua CEO Gary Bracey.

"It might take a year or two, but undoubtedly a whole new genre will be created, offering more accessibility to the many who don't yet play 'proper' video games."

So what's been getting in the way of this happening so far? What are the last wrinkles that need ironing out? "There are a few reasons for this, such as price point – VR headsets are still expensive for the average consumer; health and safety – there's still a big issue with nausea and eye strain; discomfort – most headsets are quite bulky, and people don't want to wear them for extended periods of time," points out Azhar. "I'm excited about the possibilities for what VR can offer once these issues have been tackled, but until we make these breakthroughs, I think we're going to continue seeing a slowdown in the appeal for VR in games in the near future."

Bracey thinks that a largely untapped aspect of VR might still provide a breakthrough, though. "Another reason VR has so much potential is because it combines both traditional gaming and aspects of social media. Now that VR hardware is reaching a point where it is no longer so cumbersome, players can experience incredibly rich digital worlds while interacting with people in their neighbourhood or across the world. The possibilities are exciting, and only limited by our imaginations."

## WHAT VR NEEDS

KEY CHANGES ON THE WAY

### LOWER PRICES

This one will take more time, as right now the technology is still expensive to produce, and therefore relatively expensive to retail. If VR can keep interest simmering for another couple of years though, costs may drop enough to make it much more competitive.

### HIGHER RESOLUTION SCREENS

Vive and Rift have thus far offered the best visual experience for VR, but the pixel density of the screens is still a little below what we would want. Higher resolutions should smooth out the fuzzy look many games have in VR.

### LIGHTER WEIGHT

The weight consideration is something that typically improves over time as miniaturisation improves and components can come down in size. VR headsets aren't as cumbersome as they used to be, but they could still improve.

### WIR

There's been some experimentation with this, and the Vive Pro and Oculus Go will provide wireless headsets going forward. This needs to become the industry norm, though in the coming years.

# ALL EYES ON AR

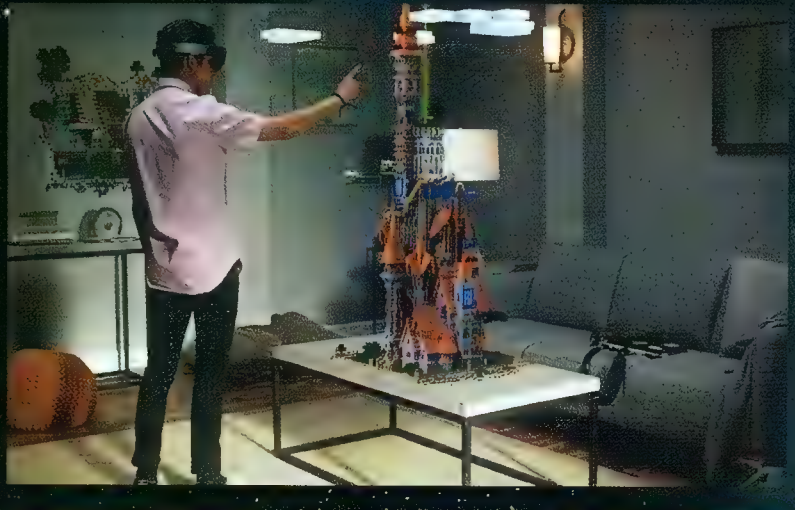
AUGMENTED REALITY IS STILL ON EVERYONE'S MINDS.

"I'm really curious to see what comes out of AR," says Tribute Games' Jean-Francois Major. "I feel like no one really figured out how to properly use AR. I wish I had the answer to this one, but I know it's not overlaying a game world in your living room."

He's right; augmented reality *can* and *should* be a lot more than that, and we're already seeing some of that in the most popular games of the last few years. *Pokémon GO* was a huge step forward for the visibility and popularity of AR gaming, bringing the creatures to life not only on screen, but in the world around us.

"Games will trial other forms of AR (for example, handset AR, as in *Pokémon GO*) more and more, but the huge opportunity is when it is absorbed into glasses, and ultimately into implants, but I suspect that will be more than ten years away," says David Braben, with a near cyberpunk vision for what the future of AR could hold. That kind of integration into our daily lives would be a big step up from where we are right now, but the acceleration with which new technology emerges and finds traction means we wouldn't scoff at his timeline prediction.

But what about right now? Can AR get a foothold immediately? Gary Bracey is betting on it with his Terra Virtua project. "We are not only focused on VR, but also actively building a strong AR component to the platform as well. We are developing a mixed reality app that enables users to stay connected to Terra Virtua even when they are on the move, and our platform will feature content specifically designed for AR as well," he tells us. This kind of broader thinking may be the next natural evolution of what AR can bring to gaming.



## HOLOLENS

HOW IS MICROSOFT'S HEADSET COMING ALONG?

From what we can tell, Microsoft's HoloLens augmented reality headset is still firmly in the connecting and testing phase at the moment, but that phase continues at pace. Recent reveals of UI tests continue to show impressive levels of accuracy and image stabilising as objects float in the headset wearer's view, and can be touched as if they were really in the world around you. We would imagine the demands of processing something like this currently sit outside what is plausible within the body of the glasses alone or even from an Xbox One X, but perhaps in another generation some console integration might be possible.

# A MORE REPRESENTATIVE MEDIUM

HOW DIVERSITY OF MAKERS AND PLAYERS IS GROWING.

Representation matters. It matters because it brings more voices into the industry and into the world of gaming, and that's important because more gamers means a stronger community, and a stronger community means more games. A more diverse industry means more perspectives, and with so much of what we love about games being the escapism of the experience, more diverse perspectives can only be good for the creativity of the projects that come our way. So representation matters, and it's a big way in which the industry will be changing going forward.

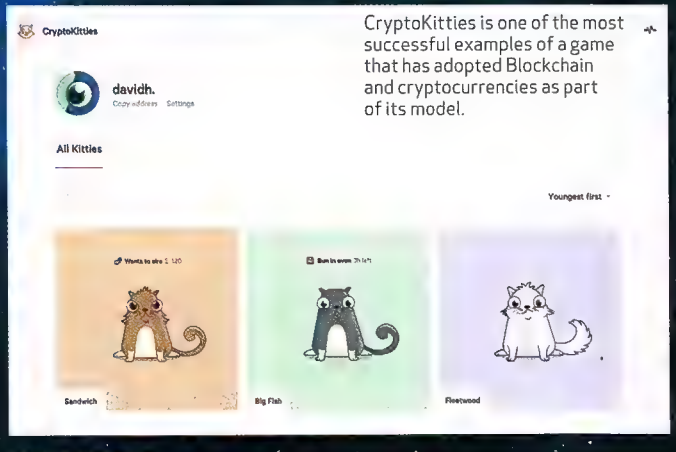
"I hope that we see more investment in diverse games and the building of diverse teams," says Creative Assembly's Jodie Azhar. "Despite a much wider range of game genres and experiences being available now than ever before, we're still seeing a lot of the more experimental games being developed by independent developers, and a lot of the larger investments are still going toward games that are seen as less risky, because they stick within an established genre with defined 'gamer' user bases."

Jeff Kaplan is hopeful though, especially as he sees another generation of game makers emerge. "I am fortunate in that I get to visit with a lot of up-and-coming game students from various universities," he explains. "I think there is so much talent in this generation, and I know they will make amazing games. The level of diversity in terms of who they are and the types of games they want to make is so promising for all of us as developers. I can't wait to make games alongside of them, and I'm very much looking forward to learning from them."

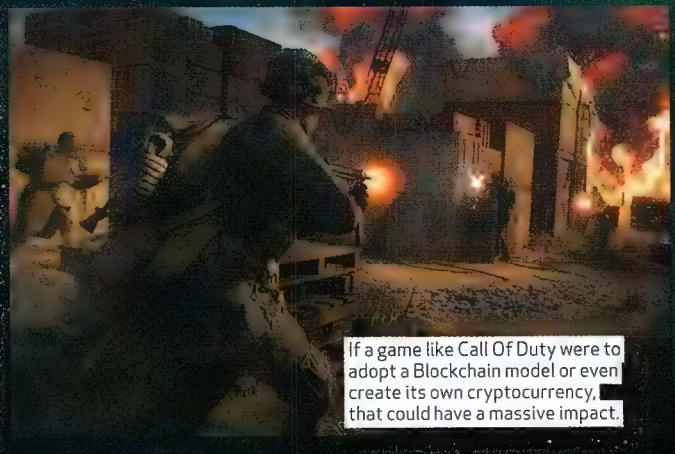
Diversity goes beyond upbringing and outlook, and also to what we even consider to be a gamer in the first place. "Looking at the diversity of people playing games, I'd love to see us get rid of this idea of a 'gamer', or that there are casual and hardcore players, and realise that anyone who plays games is a legitimate consumer in the same way you don't need a special identifier to say you enjoy watching films," says Azhar. "Games can be played and appreciated by everyone, and I'd love for the enjoyment and discussion of games to be a much more inclusive environment."

# BLOCKCHAIN AND GAMING

FIVE THINGS YOU NEED TO KNOW ABOUT HOW THIS TECH COULD CHANGE GAMING




CryptoKitties is one of the most successful examples of a game that has adopted Blockchain and cryptocurrencies as part of its model.



If a game like Call Of Duty were to adopt a Blockchain model or even create its own cryptocurrency, that could have a massive impact.

## YOU'RE THE OWNER

So breaking down things to the basics here, Blockchain is essentially peer-to-peer file sharing gone large and super encrypted, but what that means for you is there's no middleman holding onto your data or leasing you access to the things you make (profiles, characters, save data and so on). It belongs to you, giving you the power over it, including the option to sell it if you wish.

## CROSS-PLATFORM IDENTITY

Since it all belongs to you, you're also able to take it anywhere you like. So create an avatar in one game, build up credit in a particular service, and there's no reason why that shouldn't be transferable to something else. It creates the opportunity for massive shared experiences across platforms, titles and apps.

## TRADING DIGITAL CONTENT

Since the Blockchain system keeps records of transactions, if you buy something it belongs to you, period. No one can copy it or fake it. It's yours. So if you were to buy a digital game using Blockchain, you basically have a proof of purchase built in. And now, you could theoretically sell that on. Yes, we mean digital trade-ins are perfectly plausible within Blockchain creating a digital second-hand market.

## NOTHING HAS TO DIE

Blockchain is decentralised and open source, so files are simultaneously stored and encrypted in multiple locations. If a game launched its online platform through a Blockchain, that would mean the community essentially protected it. If the developer went bust for some reason or moved on, the game could be running for as long as the players kept it alive.

## IT'S SECURE

Blockchain has been used to transfer cryptocurrencies for years now, and by encrypting every piece of data and then bouncing it around a decentralised network of nodes, it's all but impossible to hack, from what we understand. That should mean better data protection for us as consumers, and possibly more stable networks for gaming.

## HOW BLOCKCHAIN WORKS

### COMPUTER

A transaction is requested by a user.

### BANK OF SERVERS

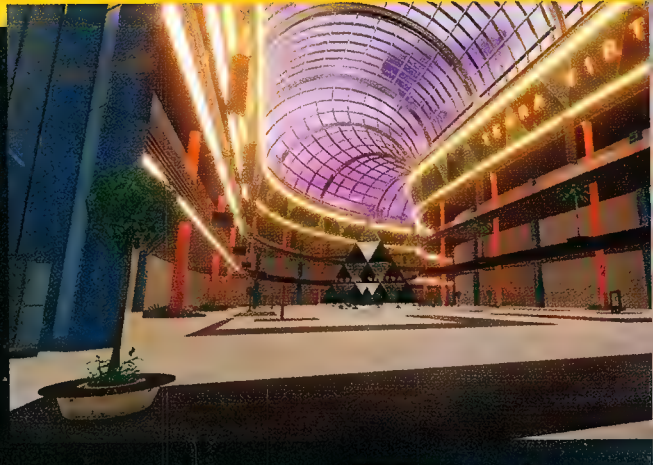
This is sent to a peer-to-peer network of computers referred to as nodes — the transaction is validated.

### A BLOCK FORMED

The data from the transaction is combined with other data to form a Block.

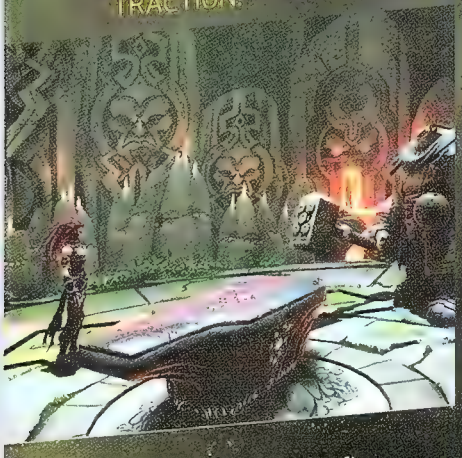
### BLOCKCHAIN

The Block is added to the Blockchain permanently, meaning it cannot be altered. The record of the transaction is now permanent and traceable.



## THE NEW MIDDLE

MORE AFFORDABLE GAMES BELOW THE TRIPLE-A ARE GAINING TRACTION.



We've been in something of a tumultuous and vicious cycle in recent years with triple-A titles. The cost of making games and maintaining gigantic development teams that can turn around a triple-A experience in two to three years goes up and up, and the price on the shelves has remained pretty steady. As a result, publishers have been trying to find new revenue streams to offset those costs in a way that makes the expense make sense while also being attractive to us as gamers. In-app purchases, loot boxes and more have been tried to mixed receptions. If the design of such purchases is off in its intention or results by even a little bit, then we tend to not be too happy about the additional investment being asked of us as players (Star Wars Battlefront II being the most-recent example). But in the face of all of this we've seen something new emerge. Or perhaps more accurately, we've seen something old reemerge with games that sit just below the triple-A tier in terms of budget and ambition given new life. The rise of publishers like THQ Nordic, who recently purchased Koch Media, shows us that there's a path for high-quality games that are operating a little outside of the system to find an audience. It's not that these games aren't high-quality productions; it's just that triple-A is moving forward so fast it's leaving a lot behind that can still work. And if these games are made a little more cheaply, they don't need to rely on post-release sources of income. They can be fairer to us as gamers and still turn a profit to keep making games. With THQ Nordic growing and other smaller publishers emerging, this could be a big area of growth as an antidote to the ever-swelling triple-A scene.

# CROSS-PLATFORM PLAY

THE FUTURE OF ONLINE GAMING, AND IT'S ALREADY STARTED.

On 12 June 1987, President Ronald Reagan famously said, "Mr Gorbachev, tear down this wall!" Over 30 years later, and it feels a lot like the games industry is calling for something similar: an end to hostilities between platforms and the beginning of open borders for multiplayer gamers. We're beginning to see the early beneficiaries of it through *Rocket League*, *Minecraft* and even *Fortnite* being playable across PC, console and smartphone, but more can be done.

"*Fortnite* and *PUBG* recently made a huge impact on gaming by having cross-platform experiences that spanned the PC, consoles and mobile," says *Overwatch* director Jeff Kaplan. "Cross-platform experiences, especially in social games or games with persistent progression, are very exciting."

The only real barrier to this thus far appears to be Sony, which prefers to keep cross play limited to PS4 with PC and not much else. Why won't it support playing with Xbox and Switch players? Perhaps because it's the market leader, and doesn't feel the need to give its competitors a helping hand. Cynical perhaps, but an understandable position if that's the case. We know it's possible though, as Epic accidentally connected PS4 and Xbox One players on *Fortnite* for a few hours in October 2017.

"I hope to see platforms open up and embrace the way players want to play more," adds Kaplan. "The technology and desire exists. I believe it would be beneficial to everyone to open platforms up more to bring players together. So I'm definitely hoping for more cross-platform opportunities."

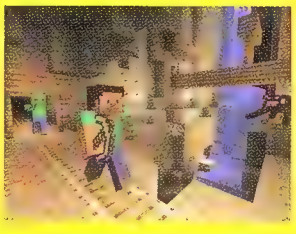
## PIONEERS OF CROSSPLAY

### ROCKET LEAGUE

*Rocket League* broke new ground when it secured the ability for PC players to be matched with either PS4 or Xbox and Switch players. Now, it is planning crossplay party support this year, adding another string to its bow.

### FORTNITE

We have to say we've been blown away by the strength of *Fortnite*'s mobile experience, and the fact that you are sharing the game world with players on PC and Mac is absolutely stunning. It just works so well.



### MINECRAFT

Mojang got to work on shared data nice and early, allowing players to visit their little shard of *Minecraft* from any device, so it made sense that playing it and sharing the experience with other platforms would follow.

# MORE GAMES WITH SUBSTANCE

AS BAFTA HONOURS 'GAMES BEYOND ENTERTAINMENT', WE LOOK AT HOW THE MEDIUM CAN PUSH FURTHER.

Recently, the British Academy of Film and Television Arts held its annual game awards, and introduced a new category, Game Beyond Entertainment. As BAFTA put it, the award was, "introduced to recognise games that deliver a transformational experience beyond pure entertainment." The winner was *Hellblade: Senua's Sacrifice* for its exploration of mental illness. But the fact that an institution like BAFTA is recognising such work says a lot about where the games industry is and where it could be going.

"I think games that cover real-world issues have been around for a long time, and should continue, too," says Frontier founder and CEO David Braben. "*Hellblade* was a worthy winner... Issues like bullying and bad behaviour can happen within multiplayer games as we all know well, and developers put a lot of effort into reducing and ameliorating some of this bad behaviour."

Taking some degree of social responsibility has been a tricky business for gaming, typically because when it comes up it is in a confrontational situation, such as violent games being implicated in real-world violent behaviour. But when everyday behaviour spills into games, developers can act, just as they can feel more confident in treating real-world issues more directly in their narratives and mechanics.

Social responsibility is something we know Blizzard's *Overwatch* team takes very seriously, so we were keen to get director Jeff Kaplan's take on this. "Games have transcended into mass culture at this point, and are widely accepted as entertainment and even art," he tells us. "With the increased accessibility of game-making, it's becoming more and more of a reality for people to express their life experiences using our medium... We know we have a voice in society, and I believe many of us are trying to use that voice for positive and constructive influence. It's nice to see BAFTA recognising those efforts."

So where can this go? We hope there's confidence that there's not only awards recognition, but also an audience who enjoy it. "I'm hopeful that we will see this side of game development grow," says Jodie Azhar, technical art director at Creative Assembly. "Games are an excellent medium for building knowledge, empathy and understanding, as the interactivity of games makes them a much more immersive experience than films or television in that the player often needs to give input to progress the game, and so has a stronger personal connection to the actions being performed and the outcome of the experience."

"The various mediums of entertainment will become more closely related," Terra Virtua CEO Gary Bracey insists. "The ability to have an even stronger narrative element in games has certainly made an impact already, but the social aspects of genres such as Escape Rooms and real-life simulations promote a stronger social aspect for more collaborative-type experiences." So perhaps a blurring of lines between mediums is where this is really all heading?

"What I expect – and would like to see – is closer integration between entertainment media," Braben adds. "This is likely to create new forms of media too, including new kinds of entertainment. We may possibly cease to see our industry as the 'games industry' but as part of the broader 'entertainment' industry – although games as we know them will continue to exist in this wider context."

## TRENDSETTERS

### HELLBLADE: SENUA'S SACRIFICE

Ninja Theory's game picked up a swathe of BAFTA awards this year, and its Game Beyond Entertainment win was a big one. Its use of sound design and mixing live action with animation created an audio and visual landscape that really immerses you in a series of potentially psychotic episodes that Senua is experiencing. An incredible piece of work from a small team.

### THAT DRAGON, CANCER

An utterly heartbreaking story, beautifully told, *That Dragon, Cancer* was inspired by the real-world experience of losing a child and the highs and lows of life under such a diagnosis. It's a stunning game, not least for the strength and bravery of its creators Ryan and Amy Green, who lost their son Joel. It's a powerful example of game as autobiography.

### THIS WAR OF MINE

Most war games have you looking down the scope of a gun or behind the controls of a machine of war, but *This War Of Mine* focused on the civilian experience and depicted the cruel and merciless repercussions of war for the innocents caught in the crossfire. It's all depicted as a survival experience, as you must gather resources and craft to keep your band of survivors alive.

### NIGHT IN THE WOODS

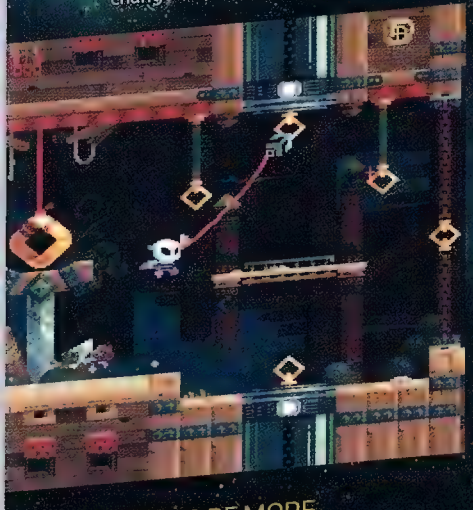
For a game that on the surface appears to be about a cat with big eyes hanging out with an alligator, bear and fox, *Night In The Woods* manages to be a moving depiction of a collapsing middle-American town, mental illness, depression and real human experiences like coming back to a childhood home and feeling disconnected. It's an amazing game.

# WHAT ARE THE BIGGEST CHALLENGES FACING THE INDUSTRY?

WE POSED THE QUESTION TO OUR PANEL OF DEVELOPERS.

## SURVIVAL OF THE FITTEST

With the games industry becoming larger, stronger, more influential and more diverse, it's crossing into the path of older forms of media, and that's going to cause frictions and opportunities moving forward. "Our industry is probably the most rapidly changing industry there has ever been," says David Braben. "Mobile phones are probably the next most rapidly changing. This rate of change is both disruptive, but also a very strong test of fitness in a Darwinian sense, meaning that the companies that can survive tend to be pretty tough to have done so. As the boundaries between the different entertainment sectors continue to blur further and further, we will see challenges from legacy media companies acquiring games companies, so this change will continue!"



## TIME TO BE MORE CREATIVE WITH VR

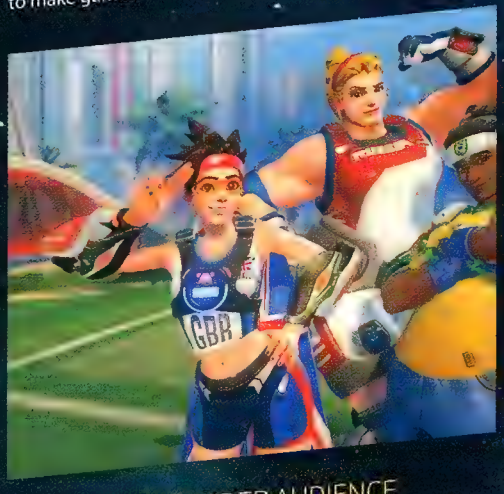
As we've mentioned earlier, it still doesn't feel as if VR has found its killer app, and without really groundbreaking work in this area, the technology will remain a curiosity rather than an integral or even leading technology. "I do think we have been slow to properly embrace VR and other 'realities'," says Gary Bracey. "Pretty much all games have just used VR as an enhancement, rather than creating whole new experiences which truly take advantage of the immersive nature of the tech. There's someone out there who will identify a whole new type of game for VR and create the proverbial 'killer app' which will finally make people say 'I must get a VR rig because I want to play that game'. This hasn't happened yet, and until it does, mass-adoption will be slow."

## WHERE NEXT FOR INDIES

Indie game makers have been enjoying a real boom in recent years, but when you look a little deeper, it's not been plain sailing. For every successful breakout indie release, there's probably dozens that got no attention at all. And a small production team doesn't mean small costs; making games remains an expensive proposition, even for a smaller studio. "The biggest challenge everyone is facing is how do you get noticed with all these releases?" says Jean-Francois Major. "Or how do you budget your game knowing the average game makes next to nothing?" The answer to these questions is difficult to determine easily. Hitching your star to a particular platform might get you some of the way, but discoverability can be a problem even for ID@Xbox titles, and especially for games on mobile or Steam. Content curation is something that still needs to be tackled.

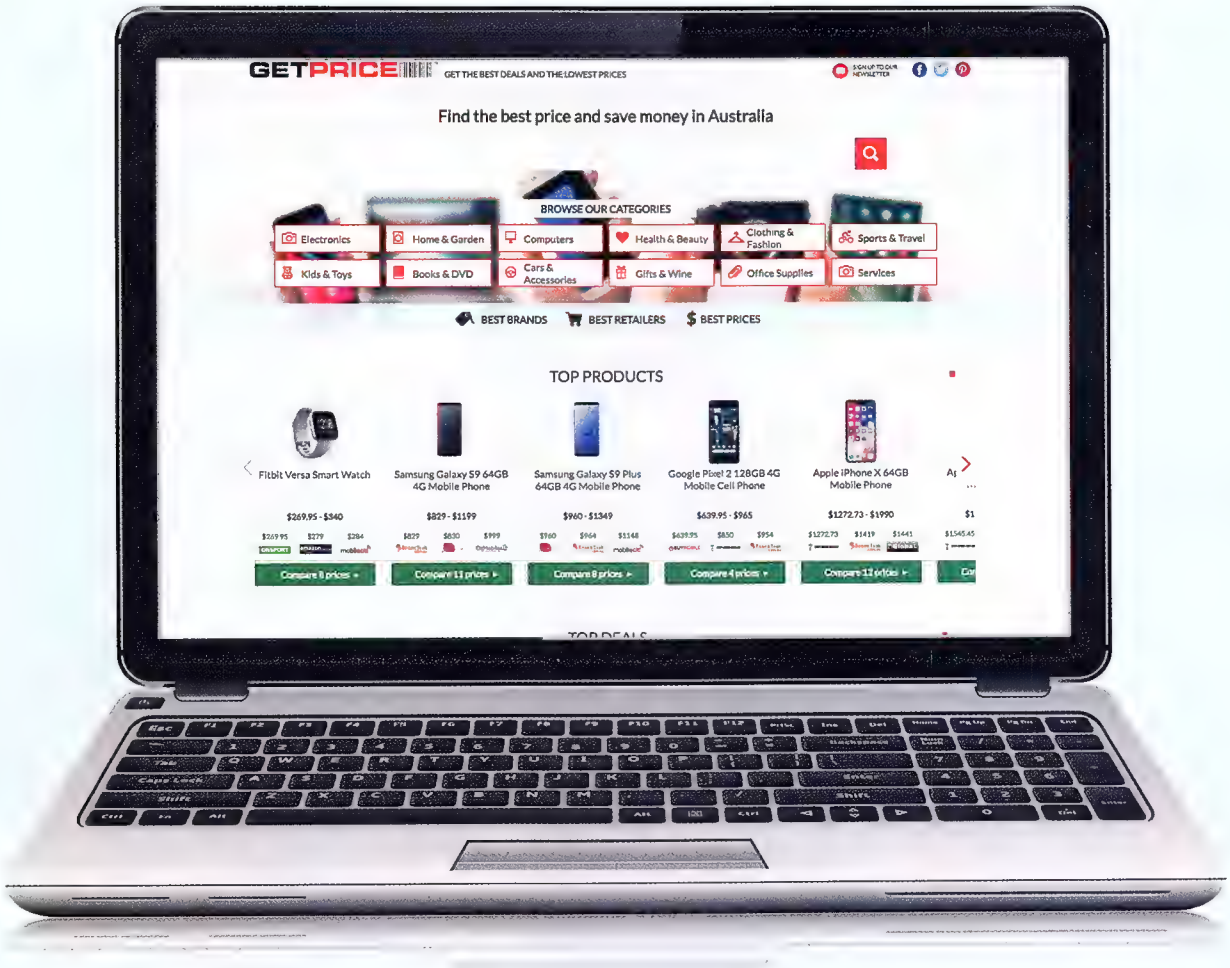
## MORE DIVERSITY AND MORE VOICES

It's often pointed out and commented upon that the games industry is still dominated, particularly in the upper ranks and most powerful positions, by white men, and that's something that needs to continue to change. "It sometimes feels like we're caught in a case of 'the snake eating its own tail' syndrome in that we would love to see more diversity in the ranks of our developers," says Jeff Kaplan. "We're doing a good job for the most part, and do enjoy a diverse group of developers. But it would be awesome to see that mixed up a bit more. Part of the problem is that we tend to make games for ourselves, so if we don't focus on diversity, we can reinforce the type of talent we attract. For example, I would love to see more games made by female visionaries in the hopes that — in turn — more females would be inspired by and excited to make games."



## REACHING THE WIDER AUDIENCE

We also talked about the diversity of the audience and how that's about not just backgrounds, but what we mean by being a gamer, and the industry can do more to bring different demographics into the fold. "I'm most excited about platforms that make games more accessible to a wider audience," says Jodie Azhar. "People of all ages are playing games, with research by Nesta last year placing the average player age in the UK at 43, and women being more likely to play videogames than men; albeit less frequently. This clearly shows the interest is out there, but for those people who aren't technologically savvy, finding out about new games that you may enjoy can be difficult." Interestingly, this is where a streaming service model might really help. "I'd love to see something along the lines of a Netflix for games where people can easily access and try out different games without feeling they need to put up a huge upfront investment," Azhar continues. "This would hopefully also encourage the idea that games are for everyone, and there isn't a hard definition of what is or isn't a game." ■

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## APPLICATIONS

### VIRTUAL TECHNICIAN WON'T RUN

***My Windows 10 upgrade has come unstuck after running like 'oiled silk'. After safely installing McAfee Anti-Virus, I tried and failed to install the complementary Virtual Technician package. McAfee's technicians point the blame firmly at Windows 10, with numerous errors in the Event logs pointing to 'Microsoft Jscript runtime error 800a01a08'. Can you suggest anything I can do to resolve this problem?***
**John Ellinghouse**

McAfee's technicians are being a bit disingenuous blaming Windows 10 – a search online revealed the error had been reported as far back as 2010, with the finger firmly pointed at the Virtual Technician program itself. We had no problems downloading and running the tool this end, and after a virtual chat with Microsoft, John returned to McAfee. This time, the problem was transferred up the ladder and after enabling the hidden administrator user account, Virtual Technician was installed successfully (and works correctly across all user accounts). John revealed that his user account is now seven years old, and originated back in Windows 7 – with this in mind, it's not surprising that occasional glitches like this occur.
**Nick Peers**

## WINDOWS

### BITLOCKER DRIVE PROBLEM

***When I plug in my encrypted USB flash drive and click on the padlock icon, I get an 'Application not found' error message. I would appreciate your assistance please!***
**John Wallis**

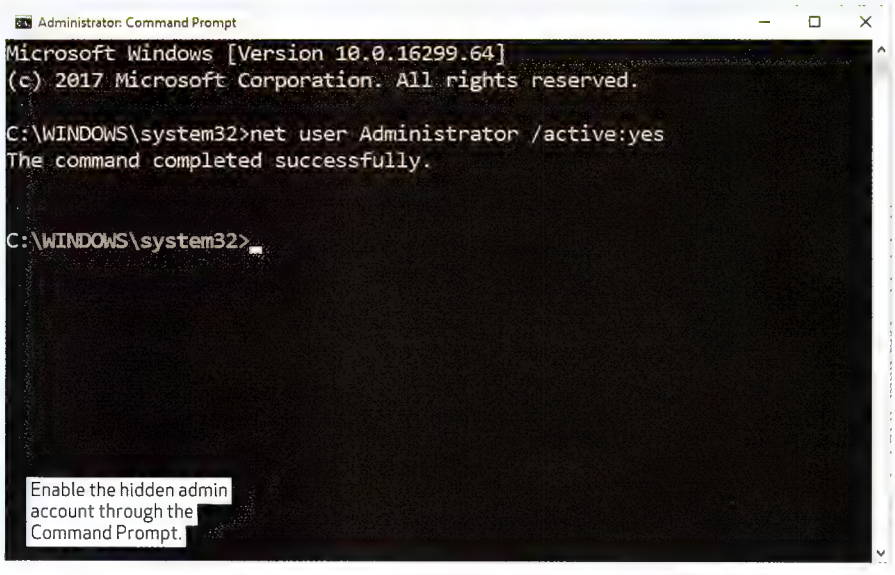
John had encrypted the USB drive using BitLocker as part of a prior Windows 7 Ultimate installation. The problem occurred on a laptop running Windows 10 Pro. By opening the BitLocker Drive Encryption Control Panel – type "bitlocker" into the Search box – he was able to manually unlock the drive and access its contents through there. Thankfully, a permanent fix to the error message is also available, involving a trip into the Registry (type "regedit" into the Search box to locate Registry Editor). Visit **support.microsoft.com/kb/2748266** for a detailed explanation of what causes the problem, but in the meantime, navigate to the following Registry key: HKEY_CLASSES_ROOT\Drive\shell\unlock-bde. Double-click the (Default) value and change it to:

```
@%SystemRoot%\System32\bdeunlock.exe,-100
```

Now expand the Command key on the left, double-click (Default) and change that to:

```
%SystemRoot%\System32\bdeunlock.exe %1
```

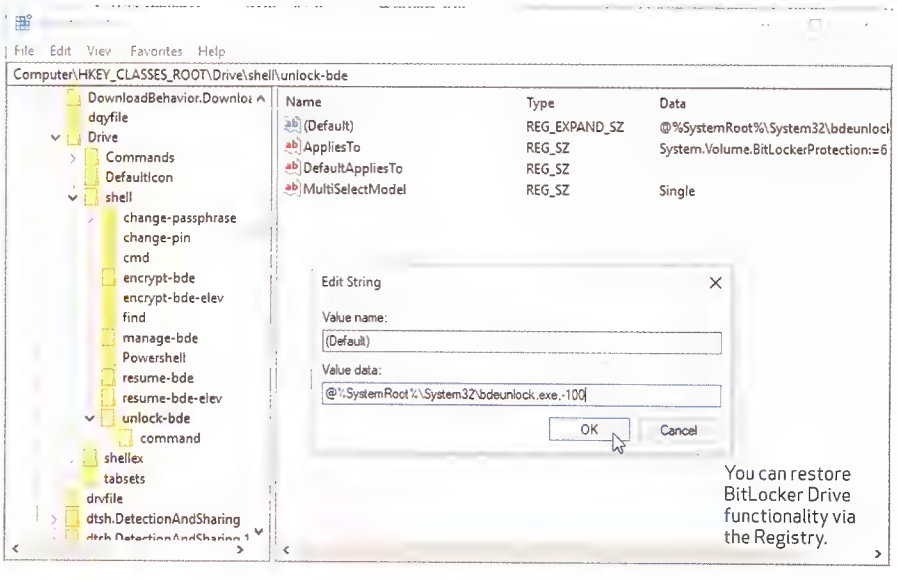
Close Registry Editor and BitLocker should work correctly again.
**Matt Hanson**


Administrator: Command Prompt
Microsoft Windows [Version 10.0.16299.64]
(c) 2017 Microsoft Corporation. All rights reserved.
C:\WINDOWS\system32>net user Administrator /active:yes
The command completed successfully.
C:\WINDOWS\system32>
Enable the hidden admin account through the Command Prompt.

## SECURITY

### WI-FI WORRIES

***I heard a while ago about a Wi-Fi vulnerability called KRACK doing the rounds. What is it, and should I be concerned by it?***
**Debbie Steadman**



You can restore BitLocker Drive functionality via the Registry.

There's a reasonable summary of the threat – dubbed KRACK (Key Reinstallation AttaCK) – at the TP-Link website (**www.tp-link.com/au/faq-1970.html**). Long story short, while the vulnerability is concerning, you need to remember that a potential hacker would have to be physically within your network's Wi-Fi range to even begin to exploit it. There are several ways you can protect yourself, though: first, download the latest security patch or update for each of your wireless devices – not just your computer or phone, but other wireless devices like smart tech, too. Most if not all of your devices should have a patch that has addressed this threat by now. Routers in AP (Access Point) mode aren't affected, but wireless repeaters almost certainly are, so make sure that these are updated, too. Second, add additional layers of encryption to your Internet connection: implement a VPN, for example, and all Internet traffic is subject to further encryption beyond the reach of a KRACK attack. These will protect you both at home and when out and about. One area where you should exercise additional caution is when using wireless technologies away from home – even paying for your coffee through a wireless Point-of-Sale machine could render you vulnerable, for example. Ask the shop whether their network connection is wired before handing over your credit card.
**Rob Mead-Green**

Focus patching efforts on your devices rather than your router.

## WINDOWS
### RESTORE ACCESS TO CONTROL PANEL APPLETS

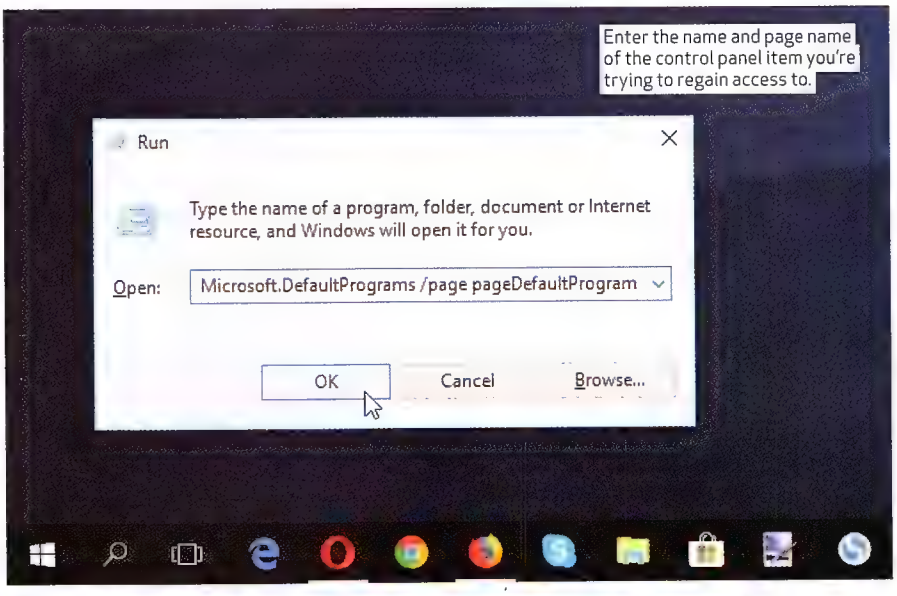
***What happened to the old 'Set Default Programs' Control Panel applet? When I click the shortcut it now diverts me back to the rubbish Settings dialog!***
**William Yearst**

The Windows 10 Fall Creators Update sent even more old Control Panel items to retirement in favour of the new Settings dialog. Luckily, the underlying features are still there – our step-by-step guide reveals how to access them.

Open your web browser and visit **bit.ly/oldcpanel+** – this points towards the 'Canonical Names of Control Panel Items' page on the Microsoft MSDN website. All items – including those deprecated in recent versions of Windows 10 – are listed here. Scroll down and click the Control Panel item you're looking for, then make a note of its canonical name plus the page name that you want to access.

Press 'Win-R', then type the following and hit Enter, substituting your chosen canonical name and page name where appropriate:

```
control /name Microsoft.
DefaultPrograms /page
PageDefaultProgram
```


Enter the name and page name of the control panel item you're trying to regain access to.
Run
Type the name of a program, folder, document or Internet resource, and Windows will open it for you.
Open:
Microsoft.DefaultPrograms /page pageDefaultProgram
OK
Cancel
Browse...

**"I heard a while ago about a Wi-Fi vulnerability called KRACK doing the rounds. What is it, and should I be concerned by it?"**

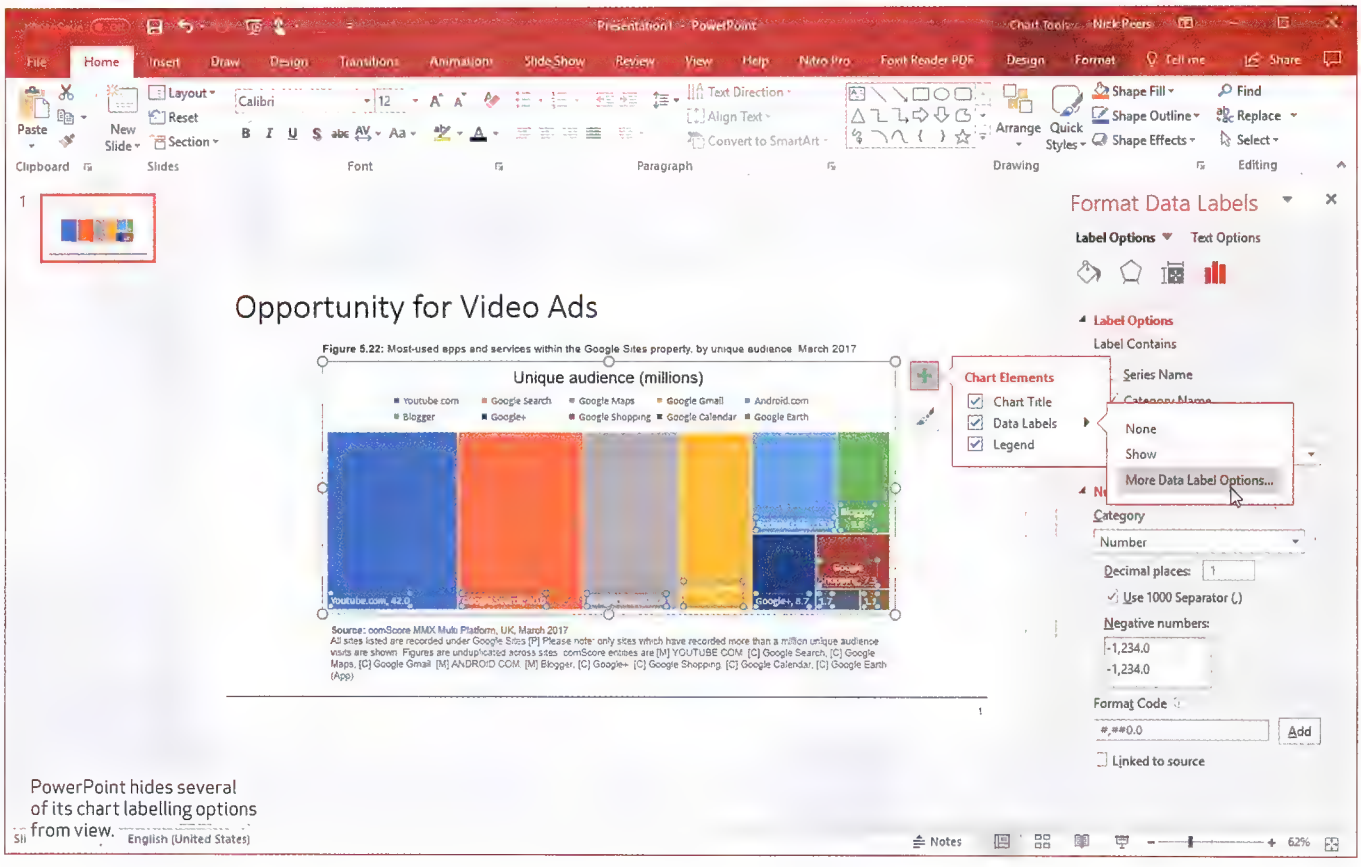
Click OK and you should now have access to the original Windows Control Panel item you were looking for. For permanent access, right-click the desktop and choose New › Shortcut, then input the string you entered in the previous step.
**Cat Ellis**

## LINUX
### MISSING BITS

***Way back in the 1990s, I developed The Digital DJ Dance Manager, which ran on a PC with Windows XP Pro. While it was written using Visual Basic 6 I would like to clean it up and rewrite it to run on Linux. The unfortunate thing is that this program enables one to use seven simultaneous displays, which isn't easily done with any of the Linux distros I've seen.***

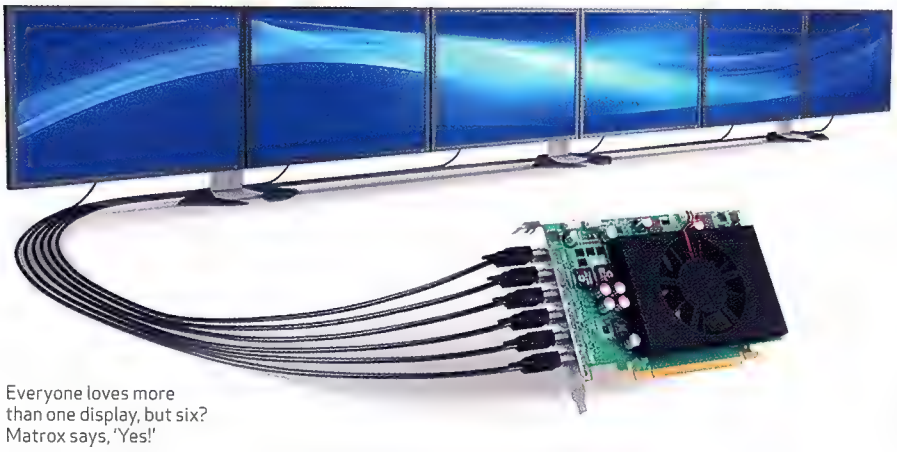
***While the current release of DJ isn't pretty, it does get around the irritations which the use of Tabs pose when using an iPad! One display with tabs is not conducive to programs like this, or for businesses such as stocktaking, banking, purchasing and particularly like multi-display video gaming. When is Linux going to make it easier to add multiple displays to its otherwise powerful system? I've regularly had to use Windows when setting up multi-display systems for use by all of my business clients — they're addicted to having more that two displays.***

***Another valuable product that seems to be Windows and Apple unique is called***




***a Wormhole! This enables one to easily connect two different systems together via the USB port and have them work as a single computer from just one of their keyboards and trackball.***
**Sam Davis**

The classic Achilles' heel of Linux is where the hardware and software worlds meet. Both the things you mention here really aren't features, but products offered through hardware vendors. The Wormhole is the easiest to address, I've never come across this, but it looks similar to the USB Direct Cable Connection that Windows used to offer to migrate installs, made obsolete by a networked option. Really, you're asking the company to support Linux with its proprietary cable solution. Much of what you're after would be achieved using a remote desktop solution such as TightVNC, which enables live screen/mouse/keyboard capture, plus drag-and-drop sharing. As for multiple monitors, from what I can tell X11 has supported multiple GPUs with xrandr since v1.4 was released in early 2013, but this needs to go hand-in-hand with driver support, too. It's not something we've tried but all the information does seem to imply Linux can power up to at least 10 displays (in all likelihood more), even across different GPU manufacturers, as long as you have the hardware to do so. Perhaps using proprietary drivers would make things easier?
**APC Team**



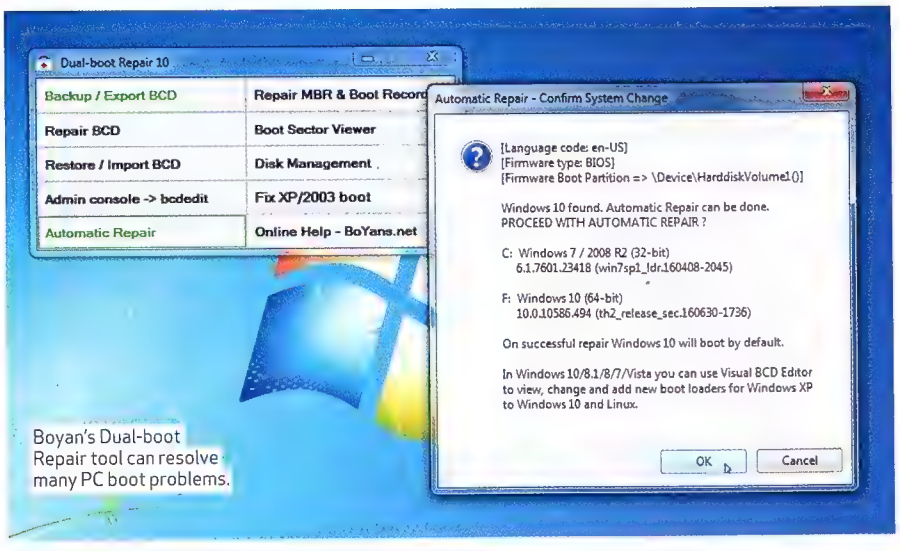
Everyone loves more than one display, but six? Matrox says, 'Yes!'

## OFFICE
## UNCOVER MORE CHART LABELLING OPTIONS

***I've created a 'Treemap' chart using Microsoft PowerPoint's Insert Chart tool, but annoyingly it doesn't appear to give me an option to display the values assigned to each part of the Treemap. Is there a way to do this without having to manually add text boxes to the document?***
**Hannah Stuart**

PowerPoint has a habit of burying settings such as these behind a bewildering maze of options. Select your chart and click the + button. It'll appear like you only have a choice of three display options – title, data labels and legend – but if you roll the mouse over the Data Labels option, click the › button that appears and choose 'More Data Label Options...' you'll reveal the Format Data Labels pane where you'll see a Value option you can tick. Expand the Number section to change how the value appears – set it to Number, for example, and you can display a decimal point or two as required.
**Cat Ellis**

HP's Envy 360 laptop contains two hard drives.


Dual-boot Repair 10
Backup / Export BCD
Repair MBR & Boot Record
Repair BCD
Boot Sector Viewer
Restore / Import BCD
Disk Management
Admin console -> bcdedit
Fix XP/2003 boot
Automatic Repair
Online Help - BoYans.net
Automatic Repair - Confirm System Change
[Language code: en-US]
[Firmware type: BIOS]
[Firmware Boot Partition => \Device\HarddiskVolume1.0]
Windows 10 found. Automatic Repair can be done.
PROCEED WITH AUTOMATIC REPAIR ?
C: Windows 7 / 2008 R2 (32-bit)
6.1.7601.23418 (win7sp1_ldr.160408-2045)
F: Windows 10 (64-bit)
10.0.10586.494 (th2_release_sec.160630-1736)
On successful repair Windows 10 will boot by default.
In Windows 10/8.1/8/7/Vista you can use Visual BCD Editor to view, change and add new boot loaders for Windows XP to Windows 10 and Linux.
OK
Cancel

Boyan's Dual-boot Repair tool can resolve many PC boot problems.

## HARDWARE

### SPLITTING DATA BETWEEN SSDS

***I'm thinking of upgrading to a laptop with two drives, one of which will be a solid-state drive (SSD). What's the best way to split Windows, applications and data between these two drives?***
**Chris Balinski**

A lot will depend on the size of the SSD drive, Chris. If it's 32GB you'll have space for Windows 10 and a handful of apps only – but if you get a model with 64GB or even 128GB, you should have ample room to run all your apps alongside Windows, ensuring both load swiftly and run responsively. You would then use the secondary hard drive both to store your data on and as a backup for your SSD drive. One trick is to set up user folders – Documents, Pictures, Desktop and so on – on your data drive and then point Windows to them. Create the folders – we suggest inside a parent folder named after yourself (so D:\Chris\Documents and so on), then open File Explorer. Under 'Folders', right-click each folder in turn and choose Properties. Switch to the Location tab, click Move and point it to your newly created folder on your data drive. When prompted, move any existing files across and you're done. Don't forget to point applications such as OneDrive to your D drive, too.
**Matt Hanson**

## WINDOWS

### PROBLEM WITH WINDOWS DUAL-BOOT

***I have a dual-boot system whereby Windows 10 Pro is installed on an m2 SSD drive and Windows 10 Home is installed on a SATA SSD. Whenever I update Windows 10 Home, I then find Windows 10 Pro won't boot and the usual start-up repair fails to work too, forcing me to restore from a system image. Can you suggest a fix please?***
**Brian Harding**

Ordinarily, dual-booting Windows shouldn't be an issue because the existing version of Windows should be smart enough to detect the other version and create a proper dual-boot setup. Brian, however, appeared to have installed the second OS while the first hard drive was disconnected, then used EasyBCD to marry the two together.

After updating Windows 10 Home, Windows 10 Pro would start to load, but then fall over, with start-up repair unable to fix things. The boot files were stored on the Windows 10 Pro drive, and Brian had been experimenting with various settings – 'hiding' the Windows 10 Pro OS by removing its drive letter prior to updating Windows 10 Home, for example.

We pointed Brian to a couple of boot repair tools: the Dual-boot Repair tool (**bit.ly/2CUgUZR**) revealed that thanks to the way EasyBCD had set up each partition, each partition thought it was the C drive after each boot, so only one copy of Windows was visible. Brian also uses Macrium Reflect (**www.macrium.com/reflectfree**), so we pointed him towards its rescue disc, which includes a tool for fixing boot problems via Restore.

Ironically, Brian reported he had no problems with a subsequent update, so for now, it's a watching brief. There's a possibility the problems may come back, in which case we'll reveal what we did in a future issue.
**Nick Peers**

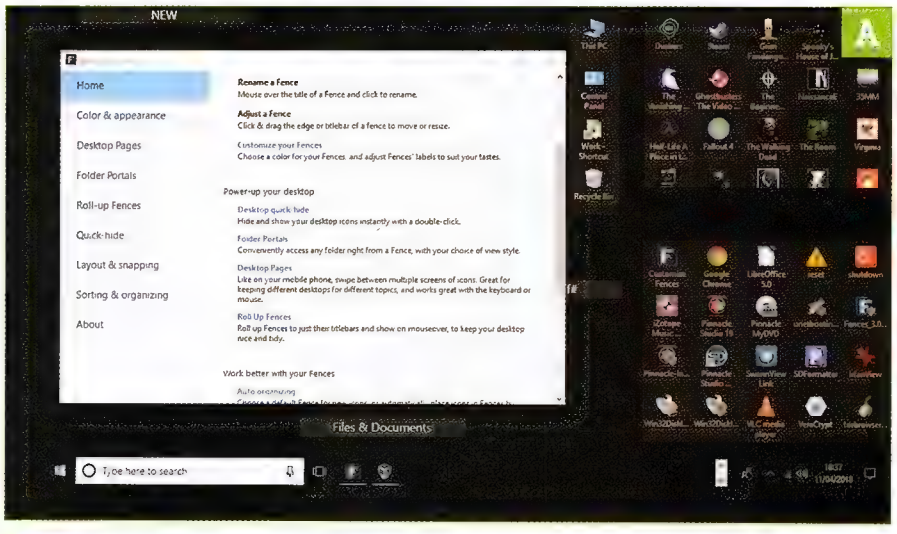
# Tweak and customise the Windows desktop

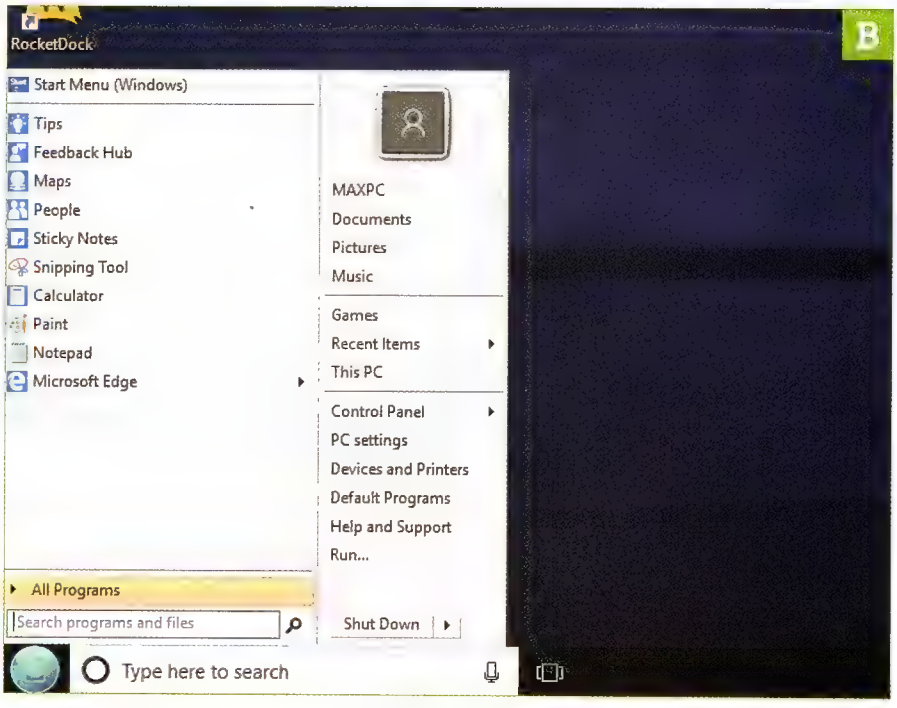
Connor MacLeod shows how to make your Windows desktop truly yours.

**Readers as old as your humble writer will know that Windows Icons Menus and mouse Pointer (WIMP) is the ancient acronym that describes the original mouse-driven graphical interfaces that span out of Xerox labs. Despite Windows 8, Microsoft was never able to kill off the classic icon-based desktop that most PC users know and love.**

We should admit to the truth, though: The classic desktop is terrible; it's as bad as a real desk. You'll leave your garbage scattered all over it – empty coffee mugs, Tim Tam crumbs and worse. It is, however, a little draconian to utterly ban the ability to keep recent items left handily on your desktop. Surely there's a helpful middle ground?

Thankfully, there's a host of clever, useful and possibly silly add-ons for Windows that push the desktop to the next level of functionality. We're going to quickly run through what we think are the best five(ish) – yes, it's a listical – that are worth your attention.




## 1 SITTING ON THE FENCE

A shorthand answer is to just buy the entire StarDock Object Desktop suite from **www.stardock.com**. For US$30 or about $40, it's a lot of slick software for your dollar. For us, though, the star of the show is Fences [**Image A**], for which there's no real alternative anywhere. Fences automatically groups icons on your desktop into flexible, movable boxes. These can be moved, hidden and resized on the fly, while a genius part is they'll all automatically scale with your desktop resolution, and as monitors are added or removed, which includes their size and positioning. It's worth its weight in gold, and the smart automatic setup can instantly tidy up the most messy of desktops. It also retains the standard desktop, so that's still there below your fences.

Did we just say there's no real alternative to Fences? We're not aware of anything as slick, but a freeware alternative called Nimi Places (**mynimi.net**) has been around for years, and visually looks good, but takes more work to set up than Fences, and we find the way it handles icons a little odd.

## 2 DON'T GO CHANGING

We don't like change around here... Do you remember Windows 8? Those were crazy days, right? But you need to upgrade Windows to keep on top of security updates, and get access to the latest releases of DirectX, and the rest. Thankfully, there's an easy solution in the form of ClassicShell (**www.classicshell.net**), where there's good news and some bad news.

The good news is that it remains the best way of transforming Windows 10 back to the classic-looking Windows 7 Start menu and theme you know and love [**Image B**]. The bad news is that the author ceased supporting it at the end of 2017, but they at least had the good sense to open-source the code, so fingers crossed, some hero will pick up support for this, and it can continue down the line. It's no joke that many people find their productivity hamstrung by the terrible changes to the Windows Start menu and other areas, so there's a genuine argument for changing things back, if that helps you.

## 3 TWEAK YOUR TASKBAR

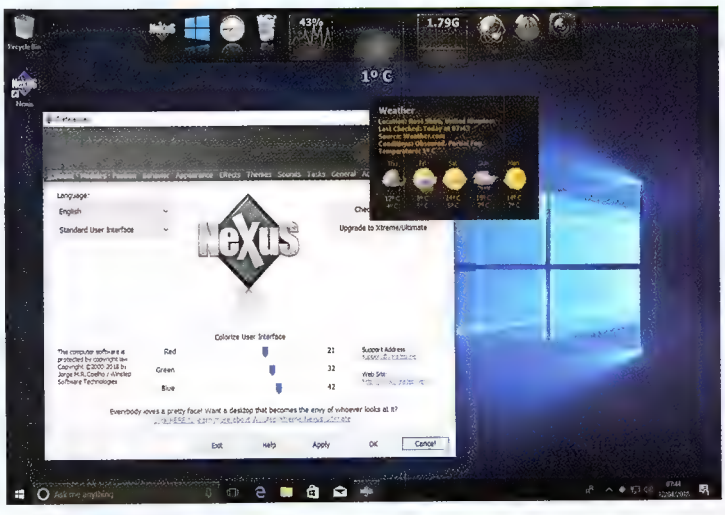
The Taskbar is an unsung hero of productivity. It lists and enables you

## Docks

If you're not content with fixing the Windows Taskbar, why not replace it?

Docks used to be all the rage when OS X appeared in 2000, but the clamour has died down more recently, replaced by the full-screen touch Launcher, we guess. It's a shame docks were often just visual fluff, as to truly replace the Taskbar, they need to offer task management and more. Two well-known docks are Rocket Dock (**rocketdock.com**) and Circle Dock (**circledock.wikidot.com/start**), but both have been put out to pasture for almost a decade, though they still both work.

One of the few docks still maintained worth a look is WinStep Nexus (**www.winstep.net/nexus.asp**), which offers a fully featured free version and a paid-for extended option. It supports Win XP through 10. The paid-for version does enhance its features greatly, including nested folders, desktop replacement with icon management, monitoring widgets, themes and more.



to control your running programs, and with Windows 10, it extends features to virtual desktops, too. Starting here and moving beyond, we stumbled across the awesome Winaero (**www.winaero.com**), which is a complete Taskbar, desktop, menu, Windows, and more tweaking tool for Windows 7, 8, and 10 [**Image C**]. We are trying to concentrate on actual productivity enhancers, but it's good to see that Winaero covers off tweaking the colour scheme of the default theme and the lock screen images.

Of more use are the options to control the Aero Shake and Aero Snap features. Dump looking in the Windows Store, and control Windows Updates more easily. Bring back the old volume controls, disable web searches, and kill Live Tiles in one fell swoop – we'd pay money for that feature. Customise the context menus, file explorer presets, and default tools.

Another easy and free way to get more from the Taskbar itself is 7+ Taskbar Tweaker (**rammichael.com/7-taskbar-tweaker**), which enables you to configure aspects of the Windows 10 Taskbar you otherwise couldn't. Turn off the grouping of pinned app windows, cycle between Taskbar buttons with your mouse wheel, assign a 'close app' action to your middle mouse button, and much more.

### 4 FLUFFY FLUFF

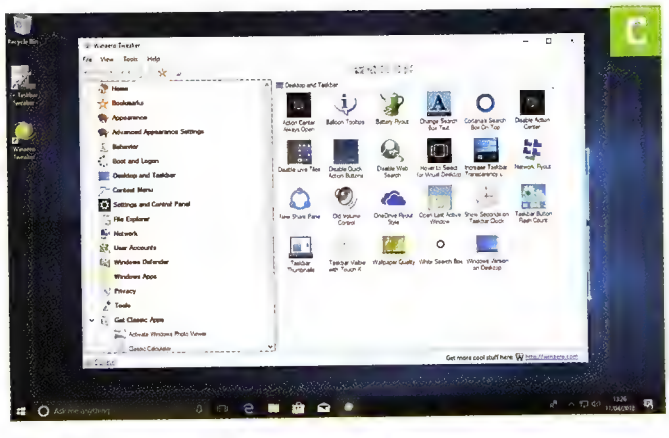
We call FolderMarker (**foldermarker.com**) fluff, but in fact, it's a genuinely useful tool. If you have a folder full of, uh, folders, how are you supposed to visually tell them apart at a glance? In Windows, you can't. Sure, system folders – Pictures, Downloads and so on – get their own icons, but user folders are all plain-Jane yellow. FolderMarker [**Image D**] offers a host of alternatives, not only plain colors but also ones with handy attached icons. These can then be easily applied via the right-click context menu.

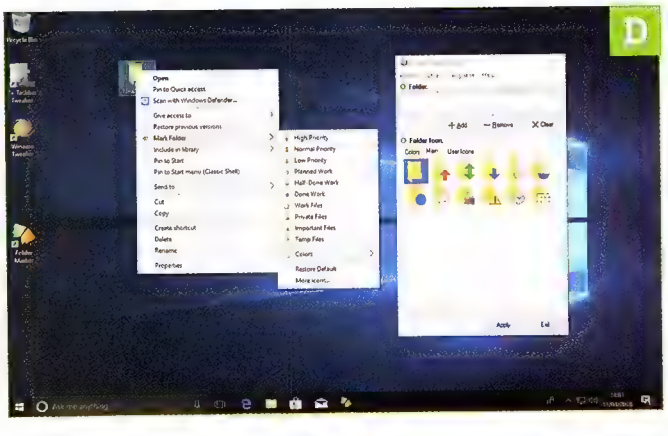
Our other fluff-based recommendation is more of a throwaway, but it seems popular, and it's CustomizerGod (**www.door2windows.com/customizergod**), and the one job it does is enable you to change any and all system icons. We personally found it a little overwhelming, and would be a mammoth timesink for little gain, but we're mentioning for completeness.

### 5 WINDING DOWN

Windows 10 does now include a night light feature as part of the Display settings, but it's rather limited in options, and can be unavailable depending on your display driver. In the past, f.lux (**justgetflux.com**) would be the go-to screen dimming tool, but we're going to suggest SunsetScreen (**www.skytopia.com/software/sunsetscreen**), which has a portable install, and a more flexible dimming schedule to match your body clock. So now you can work to the wee hours of the night, and not destroy your natural biorhythms with blue-soaked light.

People can get very territorial about changes to their beloved desktops, but who can blame them? You spend years getting used to working one way, and almost overnight, you're expected to change to a new system. So many of the tools here are geared to changing new systems to work like the old ones, but choice is good, and you're free to choose what you'd like to customise or not!



# Customise notifications in iOS's Mail app

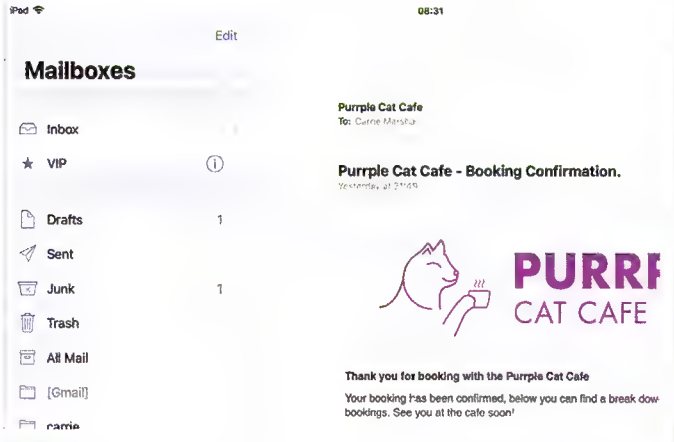
## Say goodbye to email interruptions with the power of Mail's VIP list and Carrie Marshall.

**You don't need to know about every email the moment it arrives in your inbox. (Don't lie, nobody's *that* important.) Most mail apps don't distinguish between spam and messages that tell you a family member has uploaded a photo to your shared album in iCloud. However, with Mail on your Mac, iPhone or iPad, you can ensure you're only informed about messages from people that matter to you.**

The trick is to add those people to your VIP list. That list is handled differently than other email. It gets its own inbox, and you can get VIP-specific notifications. That means you can have Mail notify you silently of everyday messages, but get the trumpets out for a message from your boss, partner or pal. The VIP list carries across to Apple Watch, too. By default, the Watch mirrors your Mail's settings from your iphone, so if you only enable alerts for VIP messages then that's all you'll get on your Watch. We're big fans of that one. Creating a VIP list is simple and really handy. Here's how to do it.

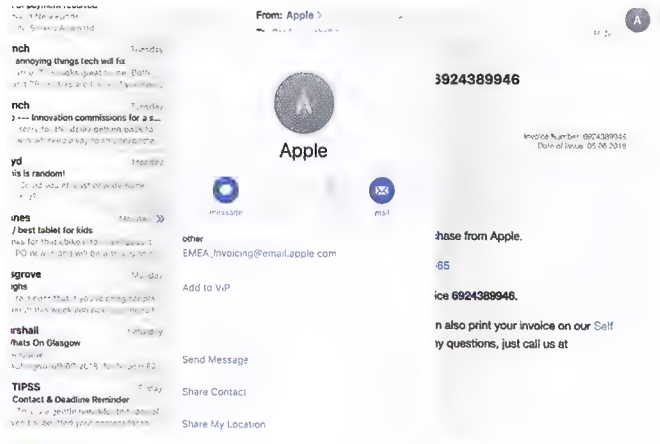
# How to:

## Manage email notifications



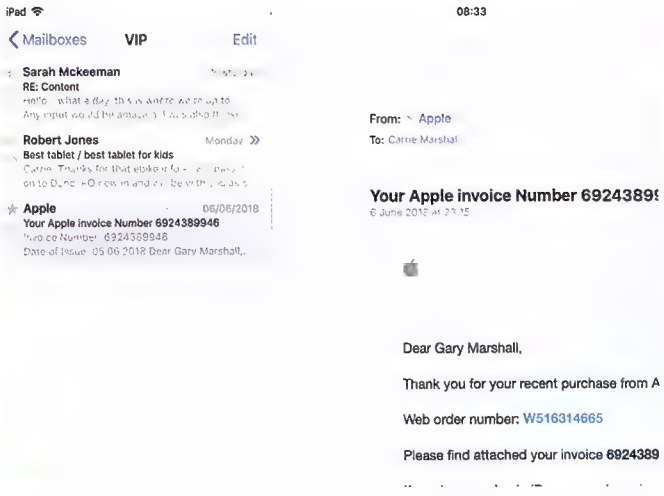

### 1 SEE YOUR VIPS

There are two ways to add a person to your VIP list. You can go to the Mailboxes list and tap the 'i' icon next to VIP to reveal your VIP list. (If you can't see VIP, tap Edit, then its row.) Tap 'Add VIP' to add a known contact.



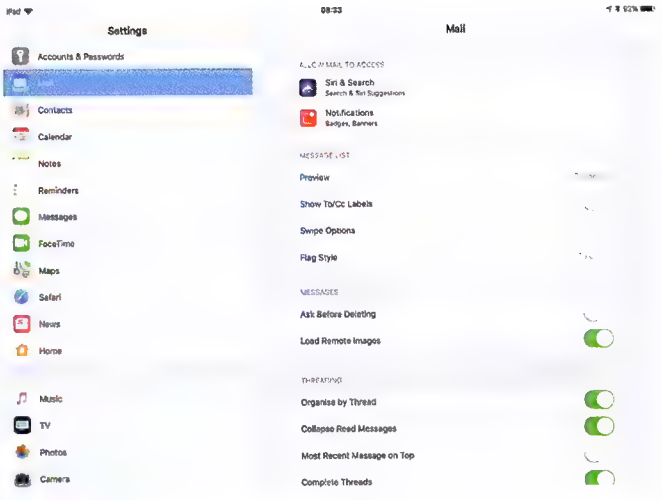

### 2 ADD FROM EMAIL

The second option is to tap Details at the top of a message, tap the sender's address or name, then tap 'Add to VIP'. This adds the sender to your VIP list without creating a Contacts card, though you can do that, too.



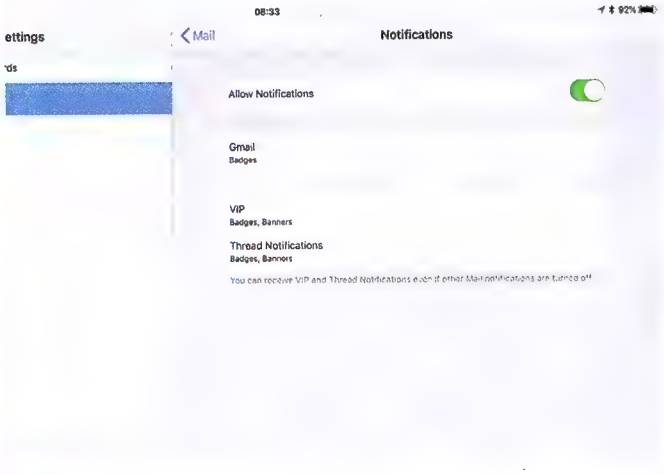

## 3 SEE WHAT MATTERS

In the Mailboxes list, tap VIP. Here, you'll see only messages from the people on your VIP list. The messages are from your inbox: if you've filed VIP emails in other mailboxes, they won't be shown here.




## 4 DECIDE WHAT TO DO

Now for the fun bit: you can treat your VIP messages differently from other emails. Go to Settings, scroll down to the fifth group (which starts with Accounts & Passwords), tap Mail, then tap Notifications.

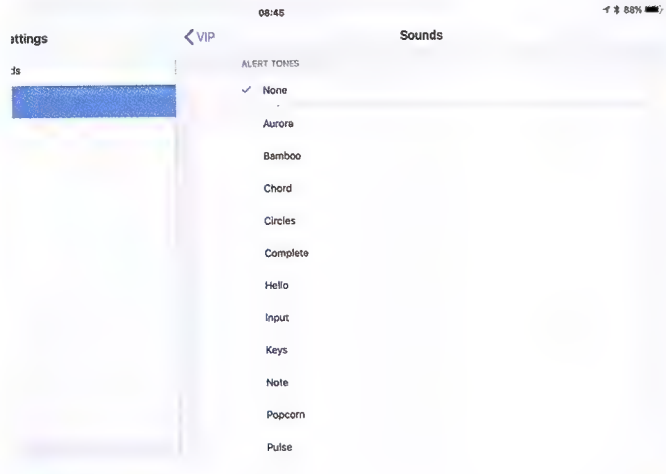



## 5 SELECT NOTIFICATIONS

When Allow Notifications is turned on, you'll see a group below that lists all of your configured email accounts. Tap into each one and think about at least turning off banners, so you aren't interrupted by every email.

## 6 CHOOSE YOUR ALERT

In the Notifications page, tap VIP. Here, you can choose how you'll be told about new VIP emails: whether your device will play a sound, and whether alerts are displayed on the Lock screen and in Notification Centre.

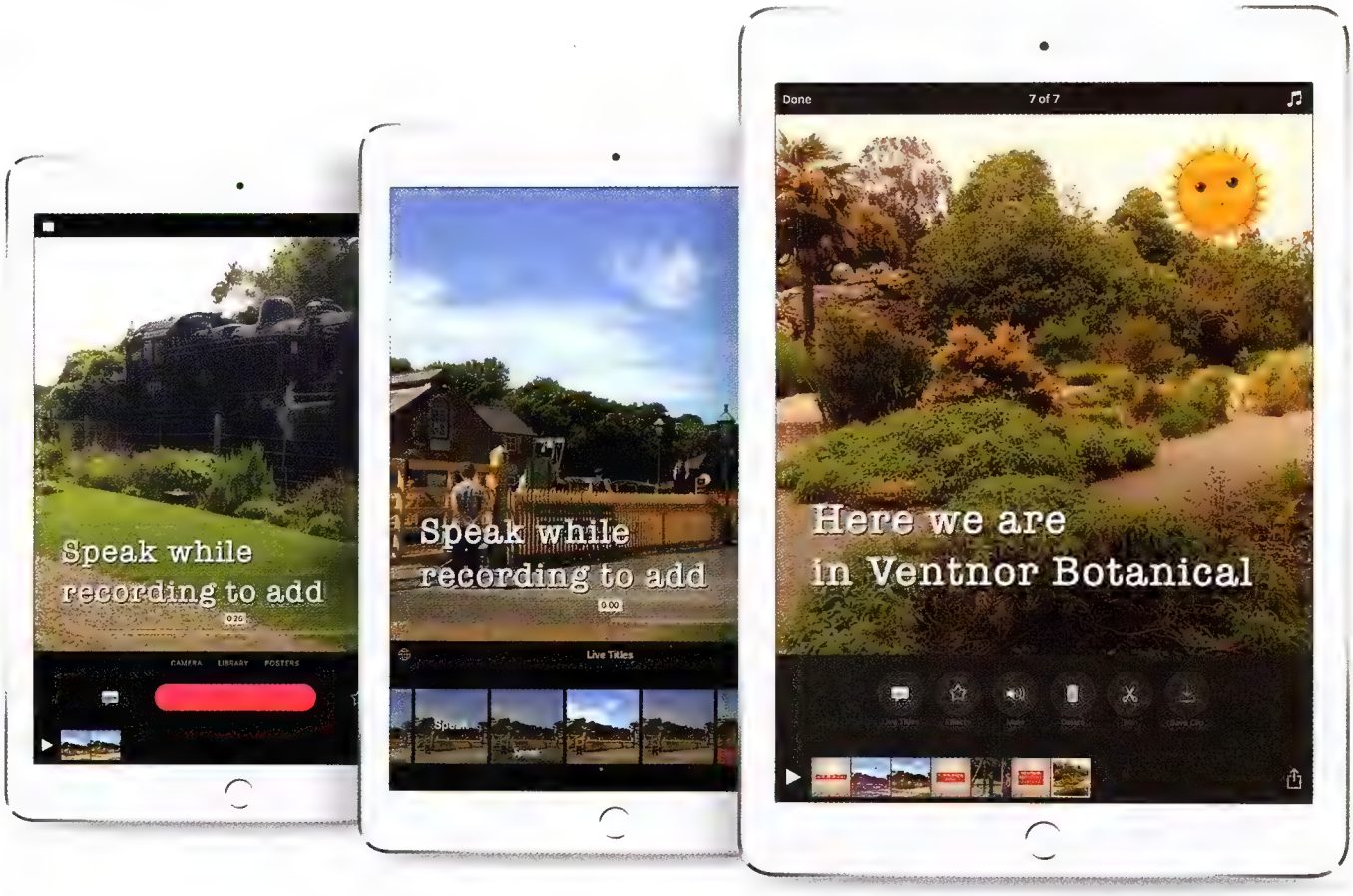



## 7 SET THE SOUND

Tap Sounds and set a completely different tone: that means when you hear it, you'll know instantly whether it's something you need to care about (assuming you left sounds enabled for newly received emails in general).

## 8 PROTECT YOUR PRIVACY

VIP messages might contain things you don't want anyone nearby to see. Tap 'Show Previews' and decide whether notifications show the contents of messages all the time, when your device is unlocked, or never.




# Create stunning videos on iOS

Nick Peers shows how to use Apple Clips to create videos that catch the eye.

**Clips isn't your everyday video-editing app. Apple designed it with social media in mind – which is obvious from the way it works with square video clips, and images that look best on mobile screens and in web browsers.**

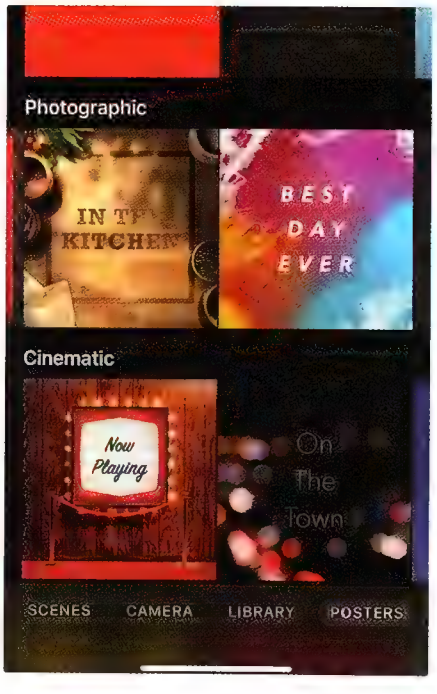
Although it can be used on the go – snap a clip, make some adjustments and share it on social media – there are lots of clever and powerful tools hidden away behind the scenes to help you deliver striking video clips complete with a veritable smorgasbord of filters and effects. You can also import clips from your iPad's library – or if you're looking for a way to spruce up an old video sitting on your Mac's hard drive, the quickest way to send it across is via AirDrop.

## MASTER THE ART OF CLIPS

The basics of Clips are easy to work with, which is why our guide opposite focuses on helping you with some of the app's more advanced features – particularly how the captioning tool works. This allows you to add on-screen text to your clips at specific points in the movie, simply by speaking the words you wish to appear. Additionally, if you're not happy with a video's original audio, consult the tip to the left for an alternative solution.

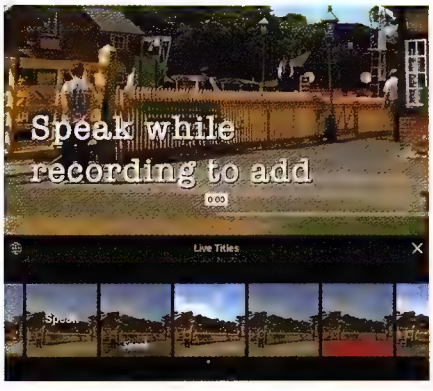
As always with image and video editing, once armed with the knowledge you need, it's tempting to emblazon your work with all manner of effects. However, before diving in, remember the golden rule of all designers and editors: less is almost always more.

Follow this rule for considered effects, and you'll find that your videos will get noticed for all the right reasons. So let's get started!

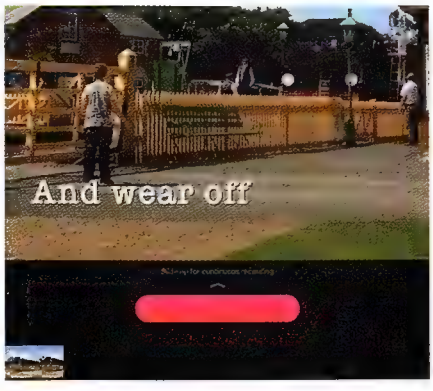


# How to:

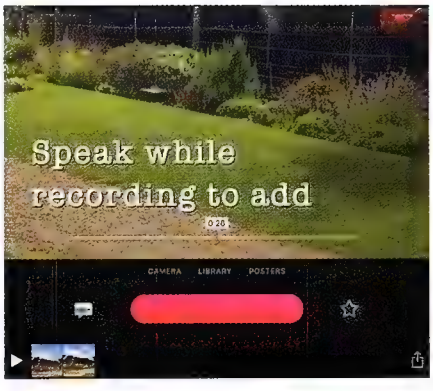
## Use Clips' advanced features



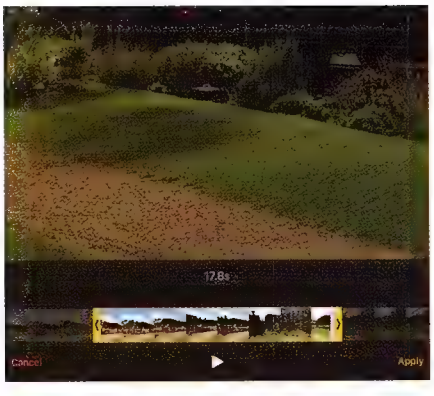

**1 CREATE LIVE TITLES**
In a project, tap Camera and choose whether to record using the front or rear camera. Tap the speech bubble to pick a look for your captions. Swipe left for more choices. (You can change this later.) Tap one to preview it, then 'X' to apply it.



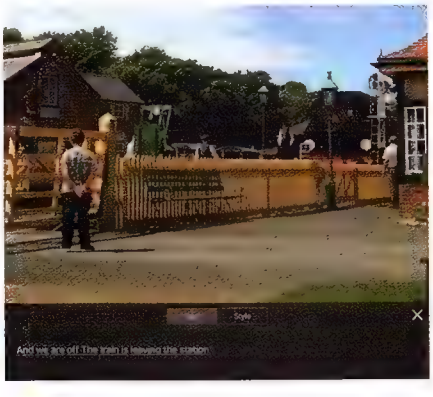

**2 SPEAK OVER THE CLIP**
Hold a finger on the record button and speak as you record. (Alternatively, swipe upwards from the button to lock in record mode.) Speak clearly and your Live Titles will appear in real time over the preview of what you're recording.



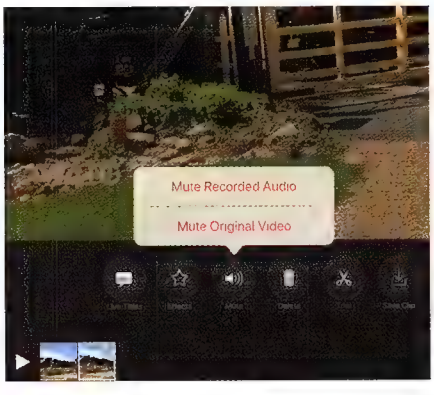

**3 CAPTIONING TIPS**
Release the button to pause the recording and finish that clip's titles. You can then create a fresh clip right after this point by holding or swiping again. Hold a finger on a clip in the timeline and drag it horizontally to change the order.



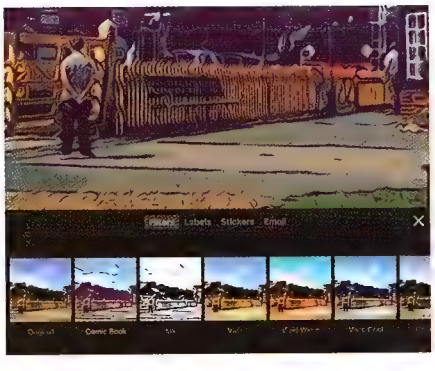

**4 FINISH RECORDING**
When you're done with recording, tap a clip's thumbnail in the timeline at the bottom to select it. Tap Trim and then drag the arrows at the left and right end of the clip to edit its start and end points, followed by Apply when you've finished.



**5 CORRECT TEXT**
The app may have incorrectly transcribed what you said. Tap a clip in the timeline, then tap Live Titles to view the text — if it's incorrect, tap the words to amend them. Note: you can't alter the text's timing in the clip, just the text itself.




**6 MUTE THE AUDIO**
By default, your speech will be heard when the clip plays — tap Mute if you only want captions. If you're adding Live Titles to a video inserted from your library, you can choose to mute your voice (recorded audio) or the original audio of that clip.




**7 ADD A FILTER**
Tap Effects and you'll be shown a selection of filters you can apply to the selected clip — most emphasise the colour or provide black and white effects, but two will change its look dramatically: Comic Book and Ink.

**8 LABELS, STICKERS, EMOJIS**
While in the Effects tool, tap Labels, Stickers or Emoji to add those elements. Labels and stickers are editable — tap the text to change it. All elements can be moved (by dragging), rotated (twist two fingers) or resized (pinch/spread fingers).

**9 ADD TEXT FRAMES**
Tap Done to finish working with the selected clip. Tap Posters for a selection of intertitles. Pick a design, then tap the text to edit it. Hold record for as long as you want the title to be. You can trim or extend its duration later, like in Step 4. ■

# Find files on your Mac faster

## Use Spotlight, Smart Folders and apps to get at the files you need. Craig Grannell shows how.

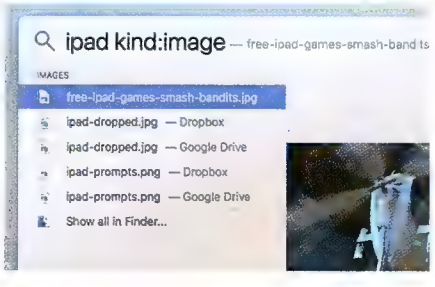
**You're probably familiar with Spotlight – press 'Cmd-Spacebar' and a search window appears. When you type, a list of results is displayed, based on what you typed, and will update dynamically as you edit your search term.**

Although Spotlight is great for opening apps – and even System Preferences panes – it comes into its own for finding documents. You can quickly navigate the results list using the up and down arrow keys, and see a preview of what you've selected in the list. To jump between categories, use 'Cmd-up arrow' and 'Cmd-down arrow'. Open an item with Enter, or use Cmd-Enter to show the item, if it's a file, in Finder.

It's possible to use natural language when searching, with phrases like "photos from last week" or "PDFs from December" (without quotes). However, the results can sometimes be a little haphazard. The walkthroughs here showcase other ways you can quickly find files – typically with a little more precision, efficiency and speed.

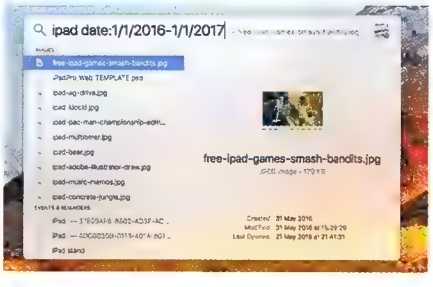
# How to:

## Search more precisely using Spotlight




### 1 SEARCH BY KIND

Typing a single word is unlikely to pinpoint the exact file you want; adding the file's kind can help. If you include extensions in your filenames, searching for things like 'dog jpg' may work; if not, try: 'dog kind:image'.




### 2 INCLUDE THE DATE

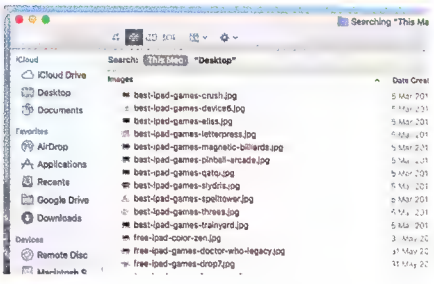
If you know the exact date you made a file, use the format "created:dd/mm/yy". To widen the search, type a range — say, "created:1/5/18-31/5/18". You can search modification date too, and before or after a date. For example, "modified:>=1/5/18".

### 3 EDIT AND COMBINE

You can combine criteria to be more specific — separate them with spaces. You can also use logical operators — AND, OR and NOT — to refine searches. For example, "kind:image NOT PSD" or "kind:image OR kind:PDF".

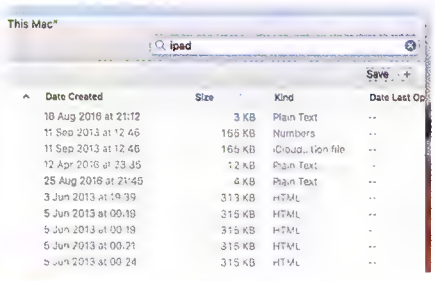
# How to:

## Create persistent Smart Folder searches



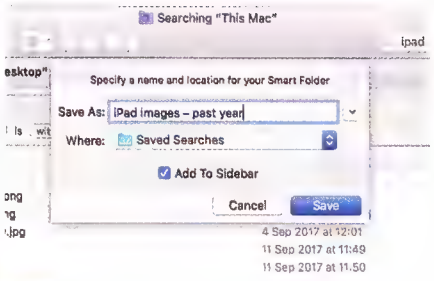
### 1 GET STARTED IN FINDER

You may find that Spotlight shows only some files that match your criteria, not all of them. Scroll to the bottom of the list of results and double-click 'Show all in Finder' to open a window that may also include extra results.



### 2 REFINE YOUR SEARCH

Or skip Spotlight from the start: in a Finder window, type in the search field; suggestions of what you might be looking for appear below as you type. Use the rules under the toolbar to search your whole Mac or within the current folder.

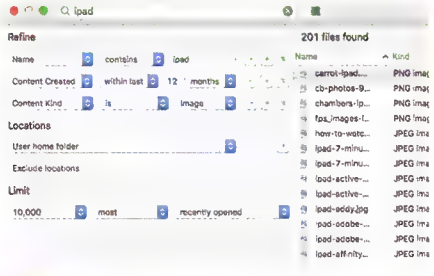



### 3 SAVE AS A SMART FOLDER

Click + (or hold Shift and click '...') to add complex criteria. Choose Other in a rule's first pop-up menu to access extra attributes. Click Save to preserve your search in Finder's sidebar or as a Smart Folder; use this to quickly rerun it.

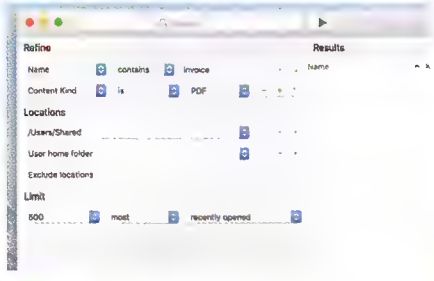
# How to:

## Power up searches with HoudahSpot



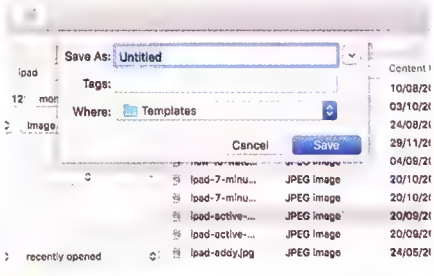
### 1 OPEN HOUDAHSPOT

HoudahSpot (US$29 (approx $40), from **houdah.com**) feels like a flexible, app-like take on Spotlight and Smart Folders. Type in a search term and press Enter to see matches. Use the Refine pane to set more complex criteria.



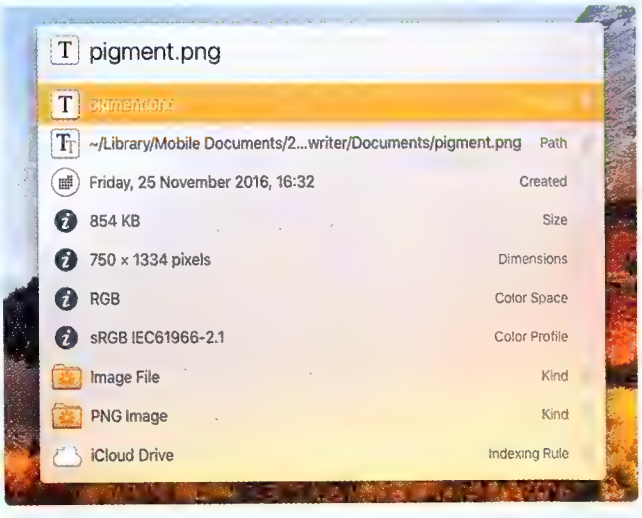
### 2 ADJUST VIEW OPTIONS

HoudahSpot is easier than Smart Folders for searching multiple locations — or excluding them. Under Locations in the Refine pane, click the + to add places, and Exclude Locations to specify one or more you want the app to ignore.




### 3 SAVE AND REUSE

Use the view buttons (top right) to see file previews/info. Like Smart Folders, you can save HoudahSpot searches for reuse: 'File > Save As Template' adds the search to the app's sidebar ('View > Show Sidebar') and Save As creates a file.




## Adding actions

### Do more with your search results

For searching alone, Spotlight and/or HoudahSpot are great. But if you want to perform actions on the files you find, there are more comprehensive choices available. In Alfred (from £19, about $34, **alfredapp.com**), select a file and then press right arrow to choose from a range of commands, including email, get info, copy and move options. LaunchBar (from US$29, about $40, **obdev.at**) is similarly powerful, and particularly great for quickly drilling down into categories and getting at item details. Trial versions of each are available.

# Get to grips with Linux file navigation

Puzzled about structure? Nick Peers reveals how the Linux file system works, plus the best way to browse it using Ubuntu's built-in file manager.

**We've seen how Linux identifies the drives attached to your PC, and you've also discovered that Linux treats everything as a file – including folders (which is basically a file listing the files that make up that folder's contents). But how are these files organised on your hard drive, and how do you access them through Ubuntu's graphical file manager, Nautilus?**

Let's start with the raw basics. Linux organises files in a tree-like structure that's a little bit similar to Windows, the major difference being that, while Windows physically separates drives into individual trees, with the drive letter at the top, Linux lumps everything together in a single file tree, with a top-level root (/) directory and everything else – including drives – placed relative to that directory.

This can sound confusing, but in actual fact, Linux provides a consistent, organised view of all the storage at your disposal. Once you understand where things are kept, it's relatively straightforward finding them again. And, actually, for day-to-day use, you'll limit yourself to your personal user folder, which is always found inside the /home directory and is where your personal documents, photos, settings and other data is stored.

What makes things even easier to grasp is that Ubuntu ships with a user-friendly file manager in the form of Nautilus, which is accessible via the Files shortcut in the launcher. Nautilus will feel instantly familiar to anyone who's used Windows own file manager, Windows Explorer, and shares many of the same characteristics.

Files and folders are represented by icons, and double-clicking one opens it. You can right-click for more options, while files can be deleted to the Recycle Bin or removed immediately (select the file, hold Shift and press Delete) in exactly the same way. The annotation opposite reveals some of the key fundamentals in using Nautilus to access and find files within the Linux file system.

## WHAT LIES BENEATH

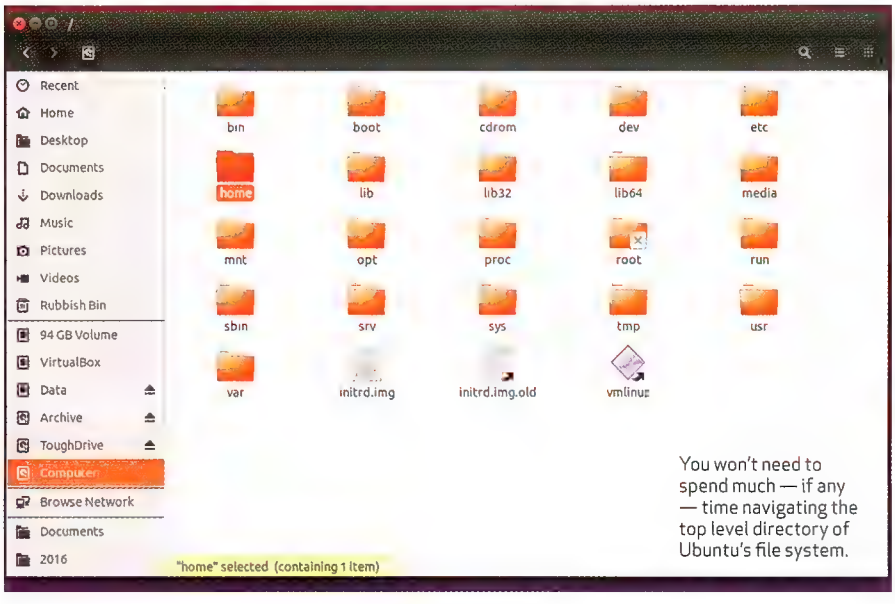
Let's use Nautilus now to identify the key folders on your system, and find out what they're for. Open it using the Files shortcut on the launcher and, by default, it'll open to your personal home folder – /home/<username> – in the Linux file tree. Here, you'll find familiar looking folders that mirror those found in other operating systems: they're all self-explanatory, aside perhaps from Public – a folder inside which you can store files that are accessible to others when they're logged on with their own user profile – and Examples. This is simply a shortcut to a folder containing the Ubuntu Free Culture Showcase, which aims to provide free wallpaper, music and video.

Next, click the Computer shortcut in the left-hand navigation pane and you'll be taken to the root directory where you'll see a large number of folders. Not all of these need explaining, but of those that do, the /bin folder is where common programs shared by all users (including root and the system itself) are installed – this includes all Terminal programs. Startup files – including the Linux kernel are held under /boot, while we've already seen how /dev contains references to your system's hardware including all attached storage devices.

The /etc folder contains many configuration files, while the various /lib folders contain program configuration data – similar to what's held in the Windows Registry. External drives are mounted inside the /media folder, while /mnt serves as a 'temporary' mount point for devices like network folders.

The /root is the home directory for the root user. It's kept away from the main /home folder in case of boot problems and can only be accessed via the 'sudo' command. Peek inside the /usr folder and you'll find 'bin' and 'lib' folders – this is where programs you install under your own user profile are kept. Finally, the /var folder contains variable data that includes potentially helpful items such as logs for troubleshooting problems.

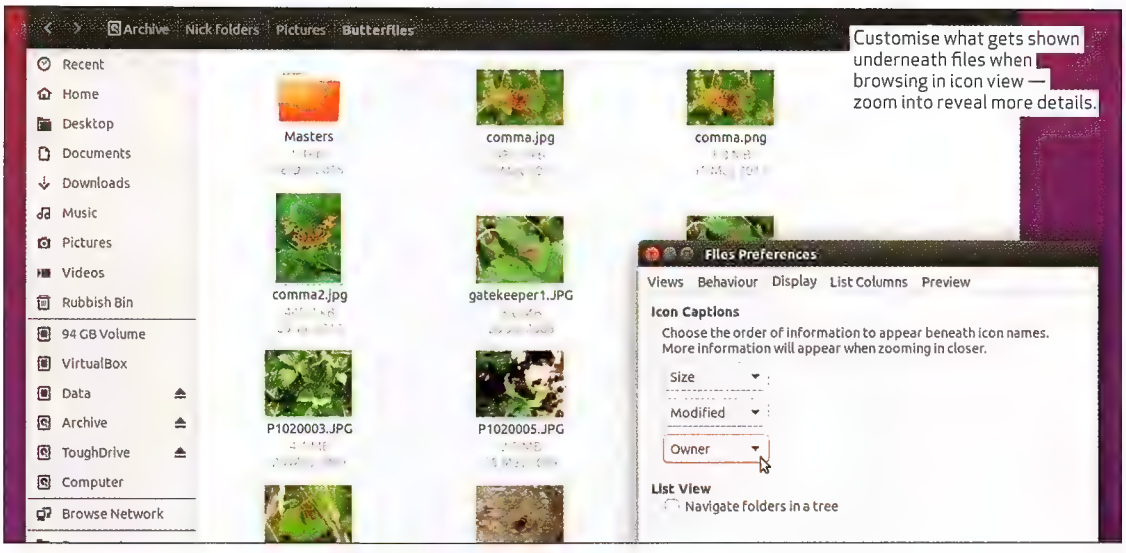
This is all interesting, and useful to know, but it's not something you should concern yourself with in day-to-day use.




You won't need to spend much – if any – time navigating the top level directory of Ubuntu's file system.

## EXPLORE NAUTILUS

Return to your home directory. Now roll your mouse up to the menu bar where you'll see Nautilus has its own selection of menus. Browse these – File, Edit, View, Go, Bookmarks and Help – and you'll see a list of familiar-looking commands, but some should



Customise what gets shown underneath files when browsing in icon view — zoom into reveal more details.

stand out. Start with 'File > New Tab', which allows you to have multiple locations open without cluttering up your desktop with windows. You'll see the tabs appear above the folder pane and you can move (or copy by holding Ctrl as you click and drag) files between them by picking them up in one tab, dragging them over another tab and then waiting for that tab to open before dropping them.

Another handy tool can be found by choosing 'Edit > Select Items Matching...' From here, you can apply filters that ensure only particular files matching those filters (such as a file type – PNG, JPG and so on) are selected. While you're exploring the Edit menu, select Preferences to tweak Nautilus' behaviour – of particular interest will be the Display tab where you can add extra descriptive captions (such as file size or owner) under icons.

You'll also notice a reference to zoom here – by default, up to three captions can be displayed underneath icons depending on how large you've magnified the icons. You'll find these controls on the View menu, or you can use 'Ctrl-Plus', 'Ctrl-Minus' and Ctrl-0 to quickly adjust the zoom level.

## HIDDEN FILES

By default, Ubuntu will hide any file that's preceded with a period (.) mark – right-click a file in Nautilus and choose Rename to see how this works, then press Ctrl-R to refresh the view, when you'll see it disappear. Don't panic – select 'View > Show Hidden Files' and it'll magically reappear, allowing you to rename it once again to remove the period mark and leave it permanently in view.

Struggling to find a particular file? Click the magnifying glass button and a search bar will pop up. Simply enter your search terms and a list of matching files will appear – if you want to widen your search to your entire file system, click the 'All Files' button.

You can also apply file type filters to your search, to restrict results to documents, photos or whatever criteria you choose. Click the '+' button, leave 'File Type' selected and then either pick a type from the drop-down menu (such as Illustration, Spreadsheet or Pdf/Postscript, or manually type a specific file extension (such as .png) to the filter. Nautilus supports multiple filters, so you could easily search for PNG, JPG and TIF photos without including GIF or other image types, for example.

## Exploring the Nautilus interface

**1 BREADCRUMBS**
As you drill through the folder tree, use these 'breadcrumb' folder icons to see where you are — click one to jump back to that folder.

**2 CSEARCH**
This provides convenient shortcuts to key parts of your system — the top section is self-explanatory, and includes a handy list of recently accessed files.

**3 NAVIGATION PANE**
You can find out how the drive has been partitioned by examining the 'Partitioning' section of its summary. It'll be GUID or MBR — see the main text for more information

**4 ATTACHED DRIVES**
All recognised drives — internal and external — are listed here. The 'Computer' shortcut provides you with a link to the root of your Linux file system.

**5 RIGHT-CLICK**
Right-click a file or folder to reveal more options for interacting with it — 'move to' and 'copy to' options are particularly useful.

Cougar's MG-110 case does everything it needs to for $50.

## Intel C6/C7 states

Since the release of the Core i 4000-series 'Haswell' CPUs, Intel chips have offered C6 and C7 low-power states, while new Coffee Lake adds C8 and C10 states. These reduce power consumption to lower levels. However, many budget and older PSUs do not support these states. As a result, most motherboard BIOSes will have their C6+ power state options disabled to allow them to operate correctly on older/cheaper PSUs. Disabling these higher C-state options shouldn't affect CPU processing performance.

# Build a quad-core Intel PC for under $500

Money might be tight these days, but you can still put together a quad-core Intel system for under $500. Darren Yates explains how.

**Give anyone a budget of $2,000 and they'd have no trouble building a high-speed PC that covers most needs. But on a budget of just $500? It sounds impossible, but with some careful design choices, you can still build a quick quad-core Intel PC with 240GB solid state drive that, all up, might not be Formula One-fast, but still packs 'hot hatch' zip.**

### DON'T SKIMP ON CPU

In days of old, a CPU upgrade path was an important consideration in a PC build – you'd research the upgrade path and time your jump to maximise the upgrade options. Now, you just buy as much CPU as your budget allows and choose a motherboard to suit, knowing your next upgrade will likely require a new motherboard anyway. However, with only $500 to buy a whole system, not just a CPU and motherboard, we won't be buying straight from the top drawer. Nevertheless, thanks to Intel's excellent Core i3-8100 CPU, we can still have four-core performance for about $160 and not surprisingly, we're making this chip the centrepiece of our new build.

But with a third of the budget gone in one hit, we've a tonne of work to do – we still need motherboard, RAM, case, power supply unit (PSU) and storage, all for under $340. For motherboard, Gigabyte's H310M-H microATX board gives us everything we need. Sure, Intel's H310 Express chipset has no RAID and only single-card gaming prospects, not to mention the board having just dual DDR4 memory slots, but it still covers all the basics – USB 2.0/3.1 (Gen.1) ports, Gigabit Ethernet, audio, HDMI and VGA ports. At around $95, it works for us – but half the budget is now done and dusted.

One area we have to compromise on is RAM. Looking at the market, you can pick up 4GB of DDR2400 RAM for roughly $65 or 8GB for $115, yet on a $500 budget, we have no choice but to go with 4GB. Still, save up your pocket money and an extra 4GB stick later should work a treat. It's also why you buy CPU power now – you want to avoid upgrades that require component-replacement.

### PARTS LIST

| PART | TYPE | STREET PRICE |
|---|---|---|
| CASE | COUGAR MG110 MINI-TOWER (SEE TEXT) | $49 |
| MOTHERBOARD | GIGABYTE H310M-H | $95 |
| CPU | INTEL CORE i3-8100 | $159 |
| MEMORY | CRUCIAL 4GB DDR-2400 | $65 |
| PSU | COOLERMASTER MWE 500 80-PLUS | $55 |
| STORAGE 1 | KINGSTON SSDNOW A400 240GB SSD | $75 |
| TOTAL | | $498 |

### STORAGE

The recent arrival of new budget TLC (triple-level cell) NAND solid-state drives (SSDs) has really crunched

CoolerMaster's MWE500 has 500W output and is 80-Plus-rated.

Gigabyte's H310M-H covers all the basics.

prices. Kingston's SSDNow A400 series has received pretty fair reviews and although the read/write speeds aren't life-changing, it has the cheapest 240GB SSD on the market locally, selling for around $75. Unfortunately, we can't afford a hard disk drive here, but again, the H310M-H's four SATA 6Gbps ports ensure adding one later is a no-brainer.

## CASE AND PSU

However, we're now left with just $100 to find a case and PSU. You have two options at this point – you either hunt down your own individual case and PSU selections, or, you look for a budget case/no-name PSU bundle. Bundles start from under $50 and while they are tempting, we'd suggest giving many of them a miss – few of these PSUs will have warranties beyond 12 months. Still, if you must go down this road, our tips will ensure your build's power requirements don't exceed 40% of the total PSU power output, and make sure to upgrade the PSU as soon as you can. PSUs are built with electronic components of a certain rating – the further you stay under these ratings, the more reliable they're likely to be. So for a no-name 500-watt PSU, stay under 40% of total output, or 200 watts.

More broadly, there are two factors affecting PSU quality and price – the PSU circuit design and the quality of internal components. A new design with high-quality components is clearly the 'holy grail', but even an older design with high-quality components is usually a solid result. Unfortunately, it's the more cost-restricted designs with lower-quality components found in some budget PSUs that can be more the worry.

Given a case still has to come out of the remaining $100, it made choosing the PSU our most difficult pick, with top-tier makers like Seasonic or Super Flower well off the menu. In the end, we opted for CoolerMaster's recent 500-watt MWE500 for a bunch of important reasons, aside from its $55 price tag. First, it has Active Power-Factor Correction (Active PFC) so it'll be a bit cheaper to run. Second, it's one of the few 80 Plus-rated PSUs you'll see this side of $60, so it's more energy efficient. Third, it comes with a three-year warranty, and fourth, it supports Intel's 'Haswell'-class C6/C7 low-power states. However, key for me is that it's rated to operate at up to 40°C ambient temperature – many other budget PSUs are rated to only 30°C or even 25°C, which means reducing your power demands or setting up a cool-room to run your system.

## CASE

Now with just $50 left in the kitty, there's little room for case luxuries. However, you'll find a number of cases around this price point. Cougar's MG110 microATX case will be a tight squeeze but still allows for a full 350mm-length graphics card at some point, so too Fractal Design's Core 1000, both selling for $49. DeepCool's roomy Tesseract mid-tower is another $49 model with two blue LED-lit fans and dust-filtering, but only handles graphics cards to 310mm. You choose.

## COMPROMISES

Yep, there's no doubt we've made compromises – but you still get a quad-core Intel-powered PC with 240GB SSD that covers all the basics and has plenty of upgrade potential. We wouldn't call it a 'renovator's delight', but you've got options particularly for storage, RAM and PSU (and yes, even CPU, for the moment, if you must). Intel's Core i3-8100 CPU has a thermal design power (TDP) rating of only 65 watts, and given the only other component of note in this build is the Kingston A400 SSD, few PSUs would be troubled by this load. That said, a Seasonic PSU, an extra 4GB of RAM and a 1TB WD Blue hard drive would round out this build nicely later on.

So, yes, you *can* build a quad-core Intel box for under $500 – just.

Kingston's A400 series offers the cheapest 240GB SSD so far.

Intel's Core i3-8100 delivers quad-core speed for $160.

# Expand your multi-room Pi audio setup

Nick Peers reveals how to develop your multi-room audio setup further by adding touchscreen controllers and Bluetooth capability. (Part 2 of 2.)

**Last issue, we revealed how to build your own multi-room audio system for the fraction of the cost of a Bose or Sonos setup using your Raspberry Pi as a server with the open-sourced Logitech Media Server (also known as Squeezebox). This issue, we're going to fill in the missing gaps by adding a range of touchscreen controllers, which provide a more convenient means of playing and managing your library.**

Think of the controller as a glorified remote control, with the added benefit that it enables you to control any or all of the players in your home setup. When Logitech was selling its own Squeezebox multi-room system, its primary touchscreen controller took the form of a hi-tech remote control, which can still be found second-hand if you know where to look.

## PiController

But why pay at least $200 for that when you have much cheaper alternatives? For example, why not press the Pi's official touchscreen into service as a fully functional controller instead? The following works beautifully with the official Raspberry Pi touchscreen, but can be adapted for smaller touchscreens too.

If you're running PiCorePlayer, then everything you need to add touchscreen support is built into the OS. Start by logging on to your Pi through your web browser – you can get its IP address from the messages that appeared on your touchscreen when you booted your Pi.

Make sure either Normal or Advanced is selected before switching to the Tweaks tab and scrolling down to the Jivelite Setup section. Start by clicking the Install button under and wait for the download and installation to take place. When prompted, click OK to reboot and switch your attention to your touchscreen to complete the setup process.

Start by selecting your language followed by a skin. Grid (800 x 400) uses large icons, while Joggler shows items in a list. Make your choice (you can switch later via 'Settings > Screen > Select Skin') and you'll be taken to the main menu when you've confirmed your choice.

## Tweak the settings

Next, tap Choose Player (remember, the controller works with any player). Once selected, any existing playlist assigned to the player in question will be displayed. Tap the music note button to view what's currently playing and access playback controls.

When browsing music to play on your Pi touchscreen controller, tap and hold on an artist, album or track and you'll bring up a context menu with various options, including playing it immediately, playing it after the current track and saving it to favourites.

The My Music and Radio buttons display similar options found on the server's own playback screen, while there's a built-in search tool. You'll also see a reference to apps – tap App Gallery to see available apps, split into categories. These contain various streaming services, but there's also an app to integrate Flickr into your controller for browsing photos.

Go to Settings and you'll find options for fine-tuning your controller. Useful settings include the ability to integrate a slideshow of locally hosted photos, an option for enabling sleep and the PiCorePlayer menu, where you can either shut down or restart your touch-enabled Pi.

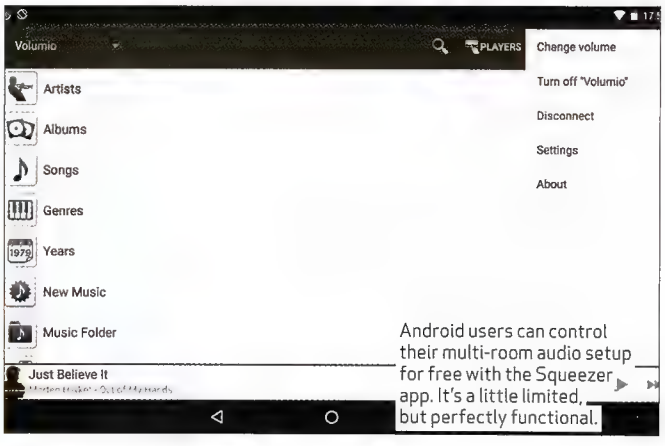
If the official touchscreen is out of your price range, the box (below right) reveals more affordable options for adding a user-friendly touch controller to your setup.

## Bluetooth speakers

We've already seen how easy it is to integrate AirPlay speakers into your multi-room audio setup, but what about Bluetooth speakers or headphones? The audio quality isn't brilliant – there's no aptX support for example – but it's a good option for integrating an affordable Bluetooth speaker into your setup.

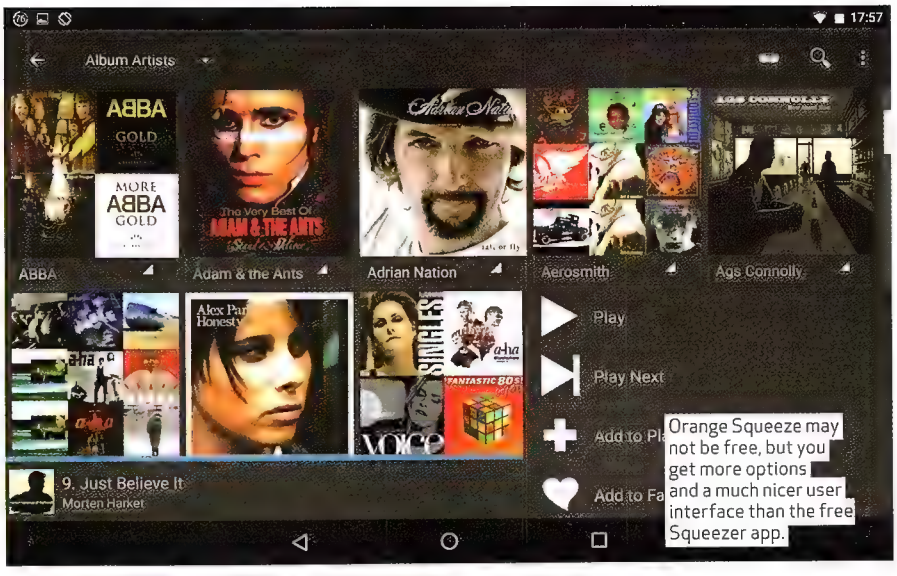
Unlike AirPlay, Bluetooth speakers need to be paired with a separate player – the simplest option is through your mobile (in which case, you'll also need a media player app – remember, you can install a plugin to add DLNA/UPNP support to LMS or purchase a dedicated Squeezebox player such as SqueezePlayer – $6.49 for Android),

The Grid skin provides you with an icon-based interface that transforms your Pi's touchscreen into the ultimate LMS controller.




Android users can control their multi-room audio setup for free with the Squeezer app. It's a little limited, but perfectly functional.

"Unlike Airplay, Bluetooth speakers need to be paired with a separate player — the simplest option is through your mobile."




but it's also possible to pair them with your Raspberry Pi player.

If you go down the Pi route, there's one major caveat: avoid using Bluetooth speakers with any Pi that's connected to your network via the 2.4GHz Wi-Fi spectrum because of interference. That means you either connect using an Ethernet cable or use the 5GHz spectrum (that means an external 802.11ac Wi-Fi adapter unless you have the latest Pi 3 Model B+).

Once again, PiCorePlayer makes integrating Bluetooth speakers a simple task, and it's smart enough to block any attempt to have both internal Wi-Fi and Bluetooth enabled at the same time unless you have a RPi 3B+.

First, switch to the Wi-Fi Settings tab – make sure 'RPi built-in Wi-Fi' is switched off and 'RPi built-in Bluetooth' is set to On before clicking 'Save/Connect' and Cancel when prompted to reboot. Now switch to the Squeezelite Settings tab and set the audio output device to Bluetooth audio from the drop-down menu before clicking Save – this time, reboot when prompted.

When you return to the browser, select the Beta tab on the Main page, then return to Squeezelite Settings and click Card Control. Click 'Install Bluetooth on pCP' Again, wait for extensions to be download and installed.

Reboot when prompted and return to 'Squeezelite Settings > Card Control'. You should see the first two items are now ticked, with only the final one – 'BT Device is Not Connected' – still disconnected. Scroll down to the bottom where you'll see options for pairing and selecting Bluetooth devices. Switch on your Bluetooth speaker, put it in pairing mode and click Scan.

Hopefully your device will be detected on the first attempt, but keep trying until it shows up and the Pair button appears. Select it from the drop-down menu and click the button. It may take two or more tries before the pairing succeeds.

Once paired, choose the speaker from the drop-down next to Select before clicking the button if 'BT Device is Not Connected' is still visible; when the screen refreshes, it should be ticked, indicating you're ready to attempt playing music through your Pi's new wireless speakers. Log on to the server or point your chosen controller to the Pi in question, and then start playback.

If it appears to be working, but there's no sound, switch off the speaker, reboot your Pi and switch on the speaker immediately after it starts to boot – this should clear the problem. Not all speakers will work – we were able to pair an Aether Cone, for example, but no sound ever came out of it; however, after a reboot, our Azatom Horizon DAB radio with Bluetooth worked perfectly.

## KEEP EXPLORING

Now you've added a controller and possibly integrated Bluetooth speakers or headphones into your setup, your multi-room audio setup is starting to take shape nicely. Keep exploring – in particular, visit the Plugins tab of your LMS server's Settings for ways in which you can expand your setup's capabilities further.

For example, as your music library grows, you may wish to create smaller, sub-libraries based around specific criteria, such as specific artists. Install the Custom Browse and Multi Library plugins and follow the guide at **wiki.slimdevices.com/index.php/Multi_Library_plugin**. In particular, the links for creating a browse menu for classical music or a dynamic menu for browsing by tags rather than genres may be of interest.

## More controller options

If you don't have a Pi with official touchscreen, there are plenty of cheaper alternatives for adding a controller to your multi-room audio setup. The obvious choice is to use your phone or tablet as a controller. Android users can control their LMS setup with the free Squeezer app, which gives you access to all the core functionality you need: browse your library, build playlists and switch players. There are playback controls, you can manage any alarms you've set up, but there are some weaknesses. One of the most notable is the lack of an Album Artists view: if this is a deal-breaker then invest $6.99 in Orange Squeeze instead, which has the missing view and extra features, too.

If you want to control your music from an Apple device, then iPad users can try SqueezePad ($7.99) or you could shell out $13.99 for iPeng, which also works on iPhone and iPod touch.

If you're desperate for a Pi-based touchscreen, but can't afford the official seven-inch model, plump for a cheaper, small display instead. If you go down this route with a 480 x 320 screen, install the **pcp-jivelite_default-wav35skin.tcz** extension (it's under the piCore Sourceforge repo, accessible from PiCorePlayer's main web interface) to provide you with a workable user interface.

# Get Android 8.1 Oreo on your PC

Still waiting for an Oreo update for your phone? Stop holding your breath and install it on your old computer or a virtual machine instead. Darren Yates shows you how.

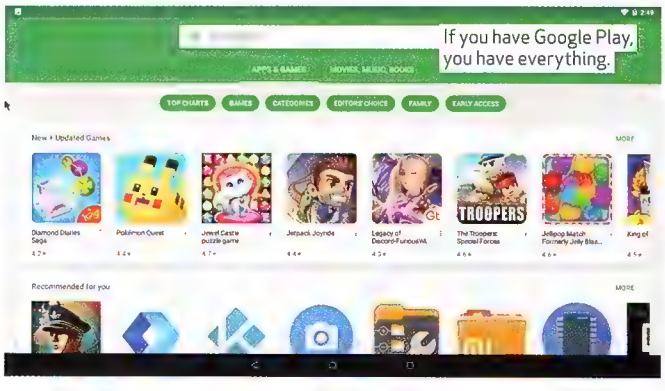
**There's no question the whole Android OS update process is a bit of a mess – some major-brand phones promised an Android Oreo/8.0 update that was announced back in September last year still hadn't received them by early July this year (mine included). In fact, we think we're at the stage of just assuming your phone won't receive an upgrade until it's booting up on your device screen. Meanwhile, if you still want to tuck into some Oreo flavour, trying pulling out an old laptop or create a virtual machine – thanks to Android-x86.org, you might just get Oreo running on a PC sooner than some phones.**

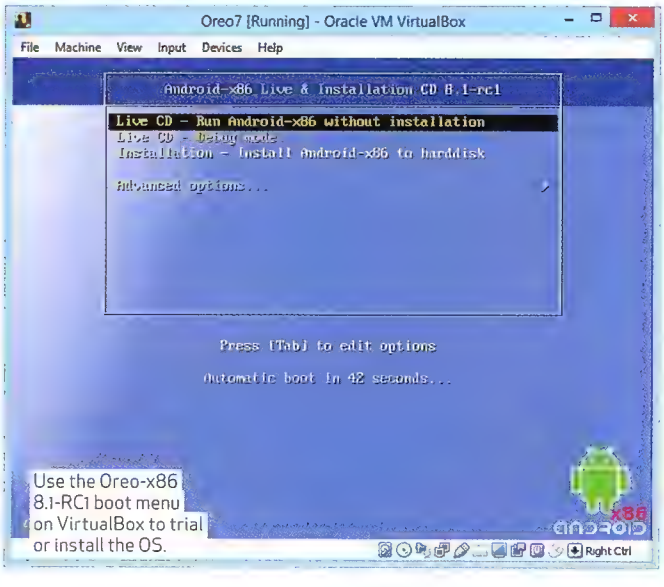
## ANDROID-X86

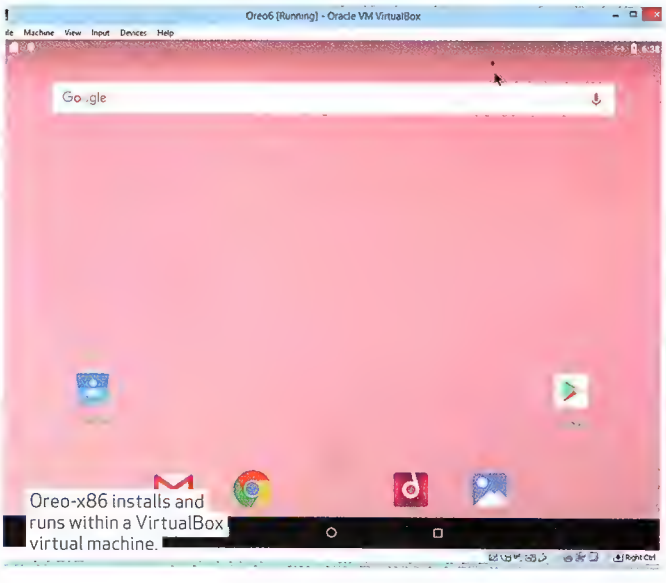
If you've never heard of it, Android-x86 is a group dedicated to bringing Android to Intel-x86 hardware. The team has built installable Android images going back to pre-Gingerbread/2.3 and recently announced the first 'release candidate' for Oreo/8.1. There are two versions – a 32-bit release for older x86 hardware and a 64-bit version for newer x86_64 kit. Choose your option from the OSDN site at **osdn.net/projects/android-x86/releases/69704**. We recommend the 'ISO' image versions (not the .rpm packages), as we'll use them to install Oreo onto an old dual-core Intel laptop and a VirtualBox virtual machine.

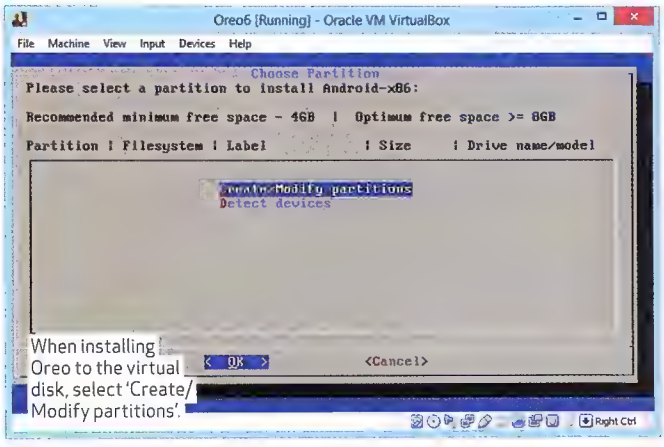
## WILL IT WORK ON MY OLD PC?

Given this is only a 'release candidate', there are no guarantees – the best we can suggest is 'your mileage may vary'. That said, it's easier to get Android running on a PC than a phone for two reasons. First, PCs generally have far more storage than phones, so it's easier for PC operating systems to include a broader range of device drivers. The Android OS designed for your phone includes only the device drivers for your phone (plus generic options such as USB Mass Storage drivers). Second, the PC platform is more standardised than Android smartphone hardware, which is why Windows can install on your PC before you've installed the motherboard device drivers. By contrast, there's no such thing as a generic smartphone – every phone comes with different combinations of hardware and because it makes no sense for phone makers to include unnecessary device drivers, phone OSs include nothing unnecessarily (well, at least as far as drivers are concerned). Oreo-x86, however, comes with a broader range of drivers than normal.

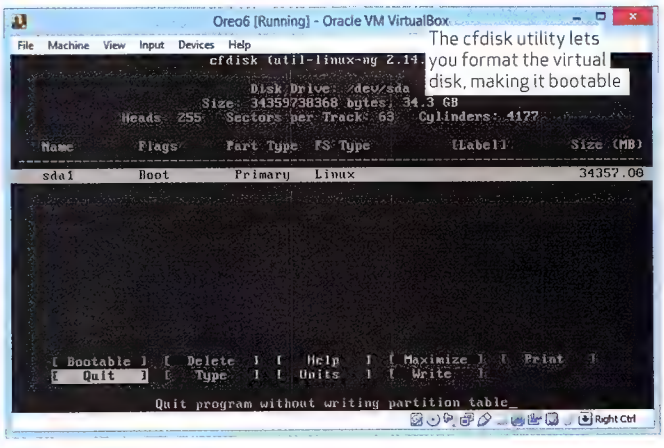




Oreo7 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Android-x86 Live & Installation CD 8.1-rc1
Live CD - Run Android-x86 without installation
Live CD - Debug mode
Installation - Install Android-x86 to harddisk
Advanced options...
Press [Tab] to edit options
Automatic boot in 42 seconds...
Right Ctrl
Use the Oreo-x86 8.1-RC1 boot menu on VirtualBox to trial or install the OS.

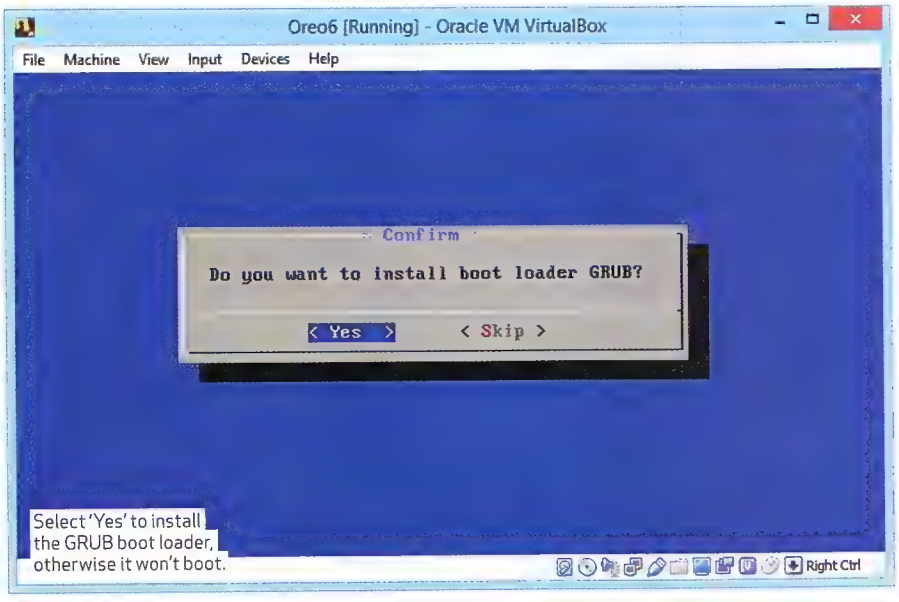



Oreo6 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Choose Partition
Please select a partition to install Android-x86:
Recommended minimum free space = 4GB | Optimum free space >= 8GB
Partition | Filesystem | Label | Size | Drive name/model
Create/Modify partitions
Detect devices
< OK >
<Cancel>
Right Ctrl

When installing Oreo to the virtual disk, select 'Create/ Modify partitions'.


Oreo6 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
cfdisk (util-linux-ng 2.14)
Disk Drive: /dev/sda
Size: 34359738368 bytes, 34.3 GB
Heads: 255 Sectors per Track: 63 Cylinders: 4177
Name Flags Part Type FS Type [Label] Size (MB)
sda1 Boot Primary Linux 34357.06
[ Bootable ] [ Delete ] [ Help ] [ Maximize ] [ Print ]
[ Quit ] [ Type ] [ Units ] [ Write ]
Quit program without writing partition table
Right Ctrl

The cfdisk utility lets you format the virtual disk, making it bootable


Oreo6 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Confirm
Do you want to install boot loader GRUB?
< Yes >
< Skip >
Right Ctrl

Select 'Yes' to install the GRUB boot loader, otherwise it won't boot.

## OUR TIPS

Do not attempt to install this directly onto your main computer, even in 'live' trial mode – grab that old laptop holding up a shelf in your garage instead. We'd also remove the working hard drive from that old system and replace it with a small solid-state drive. Out test Compaq laptop has an old 64GB OCZ Vertex SSD – too small for Windows, perfect for Android.

Even so, this process is somewhat complex and probably best not tried if you're a total beginner, unless it's on hardware you're don't mind wrecking if it all goes pear-shaped.

Oreo-x86 installation takes up 5.9GB, but if you don't have a spare PC, try a virtual machine via Oracle's open-source VirtualBox. We'll get to virtualisation in a moment.

## CREATE BOOTABLE USB DRIVE

Android-x86/Oreo operates as a 'live' distro, meaning you don't have to install it on a system drive like Windows in order to give it a test run. Personally, I still wouldn't even trial it directly on your main computer, just in case something goes wrong. If you've played around with a Linux 'live' distro, it's a similar deal. The first step to getting Oreo on your old system is to create a bootable USB drive from the ISO image you downloaded. For that, grab the UNetbootin tool from **unetbootin.github.io**. There are versions for Windows, macOS and Linux – we'll use the Windows version. However, before you launch the tool, plug in a USB flash drive into your PC and make sure you copy off any files you want to keep – they won't be there when UNetbootin finishes writing Oreo.

Any flash drive of at least 1GB capacity will do – Android-x86 uses a compressed filesystem, so the ISO image only expands marginally when written to the flash drive, from 675MB to 685MB, so a 1GB or larger flash drive will be fine.

Once you've backed up any important files, launch UNetbootin – there's no install, it just runs. When the app appears, ignore the 'Distribution' option at the top and click on the radio-button next to 'Diskimage'. Press the '...' button to the far-right and select the ISO image you just downloaded. Next, select your flash drive letter from UNetbootin's 'Drive' combobox and when you're ready, press the OK button. It'll take a few minutes to write but when complete, you should have a working bootable Android Oreo flash drive.

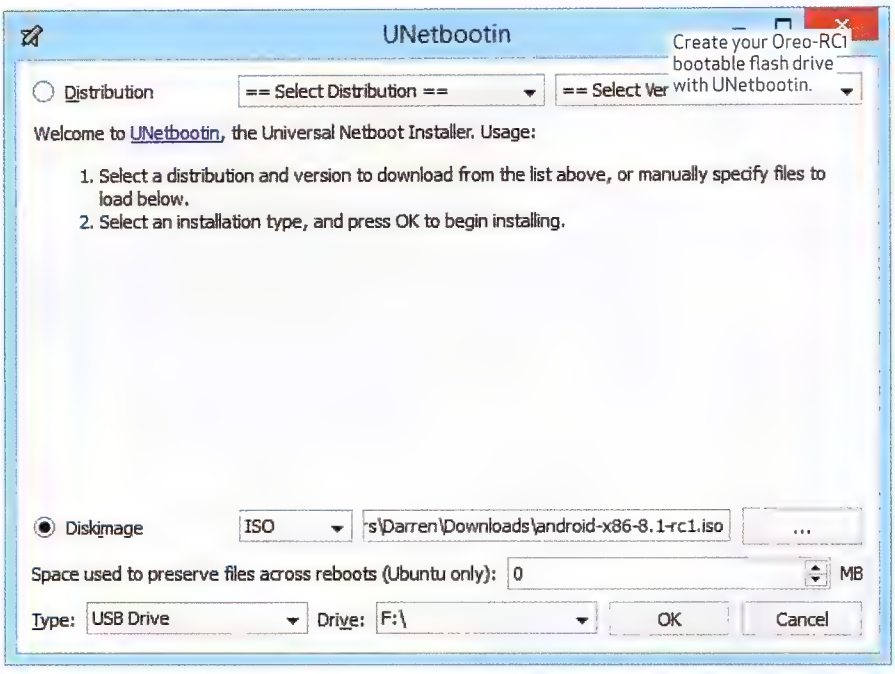
## INSTALLING OREO ONTO YOUR PC

The first thing you must do before the actual installation onto your old computer is set it to boot from the USB flash drive – for that you'll need to plug your freshly made bootable flash drive into your old system, boot up into its BIOS boot options, select the flash drive, save settings and reboot. After rebooting, you should come up to a DOS-like menu screen. There's an 'audo-installation' [sic] option that allows for a simpler automated installation of Android onto your old computer's internal drive, but again, be warned – if that drive has files on it that you want to keep, back them up before-hand because they won't be there once the install write process begins. As you go through the DOS-based install screens, you'll need to select the drive and confirm install. When the install is complete, remove the bootable flash drive and reboot.

Once the system reboots, you should eventually get into Android's initial language setup screen – if you've ever set up an Android device before, the process should be familiar.

## HARDWARE SUPPORT

What hardware should you expect Android-x86 Oreo/8.1 to support? That's hard to define, but we'd suggest the older your test system, the more likely more of its hardware will work – to a point. Android doesn't support optical (CD/DVD/Blu-ray) drives and Android-x86 is no different. However, we found that just about everything else in our test Compaq Presario CQ42 laptop worked straight away. We had no trouble with USB flash drives – you just plug them in and within a few seconds, they'll mount and appear in the Files app. From our flash drive, we also had 720p HD MPEG4 video playback with sound coming from the speakers and no dropped frames. We had the laptop's full 1,366 x 768




pixels of resolution available, even working Wi-Fi first-go, along with the physical keyboard and mouse trackpad. Pressing the laptop's power button brought up a basic shut down/reboot menu on the right side that worked as requested. Screen brightness controls, both keyboard-based and in Android's Settings menu, also worked nicely.

As we said before, we can't guarantee all of your machine's hardware will have ready-to-go driver support, but from what we've seen so far, Android-x86 Oreo-RC1 looks pretty good on that front.

## SOFTWARE SUPPORT

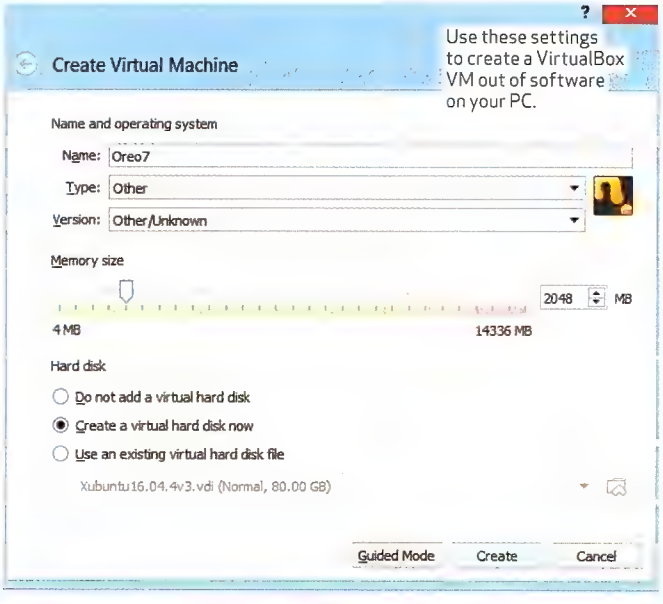
The nearly-6GB footprint of Oreo/8.1 might seem quite high, but there's little fat in that – it's basically just a standard Android Open Source Project (AOSP) platform build. The most important software inclusion is the GApps (Google Apps) install, which gives you Gmail, Chrome web browser, Google Play and YouTube apps ready to go. Importantly, and somewhat surprisingly, this Oreo/8.1-RC1 release includes root-access, plus the Superuser app to handle SU requests. Ultimately, though, this allows you to build your choice of system – nice and lean, or loaded with all your favourite apps.

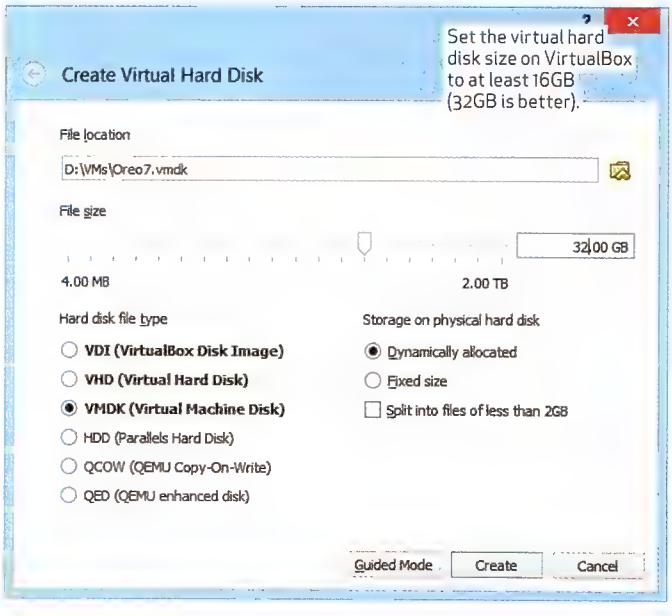
## INSTALLING ON A VIRTUAL MACHINE

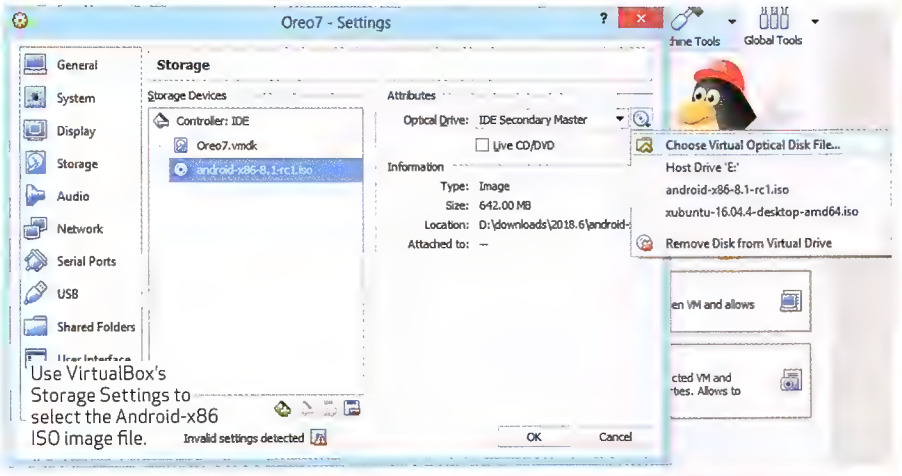
If you don't have a spare computer, the other option is to make one out of software, using virtualisation. A virtual machine is a computer made out of software, but it still needs to siphon off some RAM and storage from your real or 'host' computer, as well as access your computer's CPU. Grab VirtualBox from **virtualbox.org/wiki/Downloads**.

Install it, launch it. Press the New icon on the Manager window. To speed up installation, press the 'Expert Mode' button when the Create Virtual Machine window appears. In the new Expert Mode, give your virtual machine a name, set the Type and Version settings to 'other'. Set the memory of your virtual machine to 1GB or 25% of your machine memory, whichever is greater. Your host computer will need at least 4GB of system RAM to allow your virtual or 'guest' computer the 1GB of RAM it needs to boot up. In the Hard Disk groupbox, select the 'Create a virtual hard disk now' radio button and press the Create button.

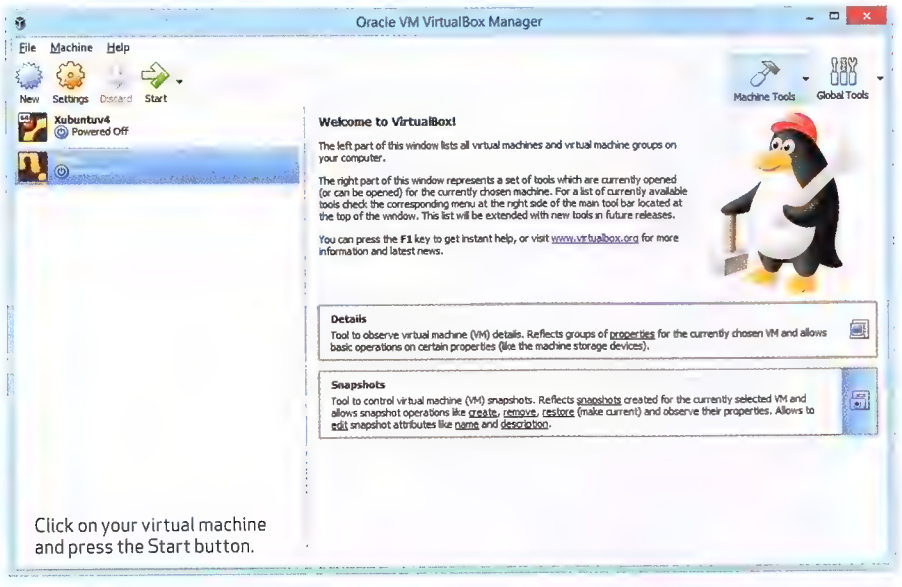
The 'Create Virtual Hard Disk' window will appear. Start by choosing the 'VMDK' radio button in the 'Hard disk file type' area, then choose a file location at the top for your virtual hard disk – this will be a file on your 'host' computer that contains the full file system of your virtual machine. Your virtual machine will need at least 16GB of storage to get started, so your 'host' computer needs at least 40GB of free storage to be safe. When ready, press the 'Create' button. This now takes you back to the Oracle VM VirtualBox Manager and your new virtual machine should be listed on the left-side. Select it and press the Settings button. When the new Settings window appears, press System on the left menu, select the Processor tab and push the Processor(s) slider to the end of the green area (that'll give your VM your system's full complement of CPU cores to play with). Next, select the Storage entry on the left menu and in the new Storage Devices groupbox, you'll see two entries under 'Controller: IDE' – the VMDK file, plus the optical device, which initially

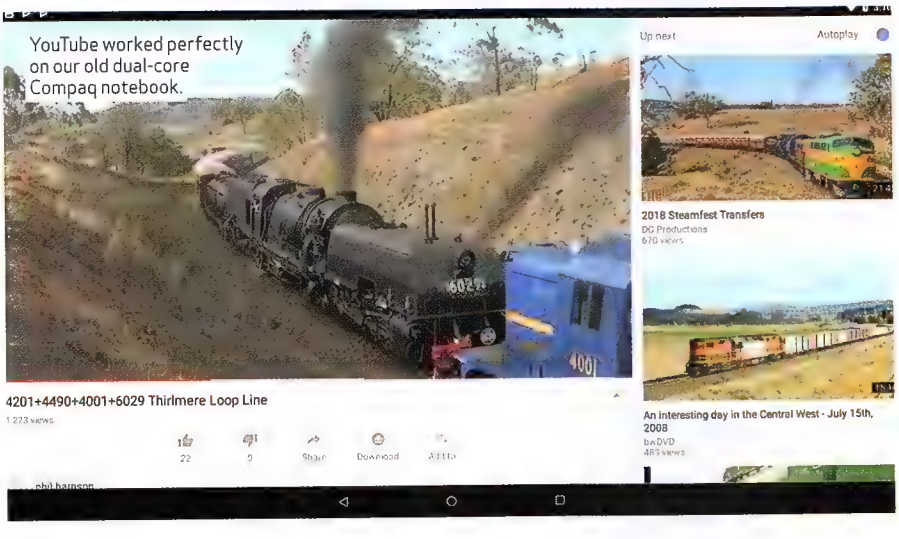




Use VirtualBox's Storage Settings to select the Android-x86 ISO image file.


Oracle VM VirtualBox Manager
File Machine Help
New Settings Discard Start
Xubuntuv4
Powered Off
Machine Tools
Global Tools
Welcome to VirtualBox!
The left part of this window lists all virtual machines and virtual machine groups on your computer.
The right part of this window represents a set of tools which are currently opened (or can be opened) for the currently chosen machine. For a list of currently available tools check the corresponding menu at the right side of the main tool bar located at the top of the window. This list will be extended with new tools in future releases.
You can press the F1 key to get instant help, or visit www.virtualbox.org for more information and latest news.
Details
Tool to observe virtual machine (VM) details. Reflects groups of properties for the currently chosen VM and allows basic operations on certain properties (like the machine storage devices).
Snapshots
Tool to control virtual machine (VM) snapshots. Reflects snapshots created for the currently selected VM and allows snapshot operations like create, remove, restore (make current) and observe their properties. Allows to edit snapshot attributes like name and description.
Click on your virtual machine and press the Start button.


YouTube worked perfectly on our old dual-core Compaq notebook.
Up next
Autoplay
2018 Steamfest Transfers
4201+4490+4001+6029 Thirlmere Loop Line
An interesting day in the Central West - July 15th, 2008

will say 'empty'. Click on the 'empty' entry, then click on the disc icon top-right under 'Attributes' and select the Android ISO image you downloaded. When you're done, press OK.

Now you'll be taken back to the main Oracle VM VirtualBox Manager window. Click on your virtual machine from the list and press the green-arrowed Start button. This launches your virtual machine and within a few seconds, you should see the Android-x86 boot menu. Select 'Run Android-x86 without installation' to fire up Oreo. This will launch a working version of Oreo-x86 within your virtual machine, which you can setup as if setting up a new phone. Just be aware that as soon as you shut the VM down, all Android settings are lost.

## PERSISTENT VM INSTALL

If you want to keep Oreo-x86 permanently on a virtual machine, you need a 'persistent VM install'. Here's how. Create the virtual machine setup as before, but when you come to the boot menu, select the 'Installation — install Android-x86 to harddisk' option. When the 'Choose Partition' window appears, select 'Create/Modify partitions' and click the OK button. Select 'no' when asked about GPT options to launch the cfdisk utility. Use the left and right arrow keys to move to 'New' and press Enter. Next, select 'Primary' and press Enter. Press Enter again to use the full virtual disk capacity you set previously and this takes you back to the cfdisk menu. Select 'Bootable', press Enter. Scroll to 'Write' and press Enter. Type 'yes' to acknowledge and press Enter again.

When the menu returns, scroll to 'quit' and press Enter. You'll drop back to the Choose Partition window, which now has device 'sda1' highlighted. Press the OK button. Select 'ext4' for the filesystem format option and press OK. Now press 'yes' to acknowledge the virtual disk will be wiped during format. Once complete, you'll be asked if you want to install GRUB. Select 'yes' and press Enter. Choose 'no' for a read-write 'system' directory, press Enter and the filesystem will be written. Once you get the 'Congratulations' screen, select 'File > Close' from the surrounding virtual machine app menu. Go back to the VirtualBox Manager window, select your VM from the left-side list and click the Settings icon. Select Storage from the left-side list, right-click on the Android-x86 ISO file entry in the 'Storage Devices' groupbox and select 'Remove Attachment' (if you don't, it'll never boot from the virtual disk). Press 'Remove' to confirm. Click the OK button on the Settings window, you'll go back to the VirtualBox Manager window, select your VM again from the list and this time, press Start. Your virtual machine will now boot up from the virtual hard disk and any changes you make will be persistent. To delete the virtual machine, including the virtual hard disk file, right-click on your virtual machine in the VirtualBox Manager and select 'Remove' from the context menu.

## GIVE IT A GO

If you want to try out Oreo/8.1 without spending up big on a Pixel2 XL or Samsung Galaxy S9, installing Android-x86 8.1-RC1 on either an old laptop or a virtual machine is probably your best bet. We found RC1 did crash on the odd occasions, but it's certainly a workable solution that'll give you a feel for the new features incorporated within Google's latest mobile OS.

# The DIY Maker's toolbox: what you need

Don't just read about making your own tech gear — do it! Darren Yates reveals the key tools and components you'll need to get started.

Arduino sensor packs come with as many as 40 environmental sensors.

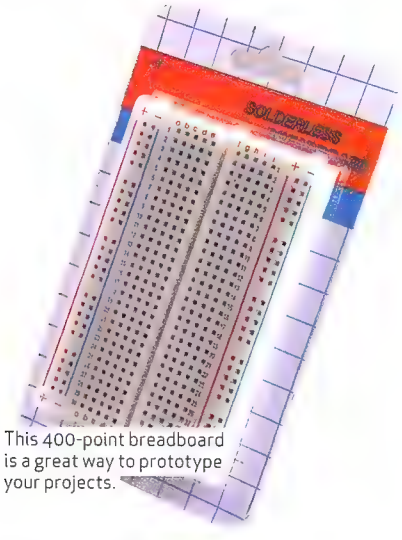
**There are few things in life as rewarding as making or fixing something yourself — not only do you gain new skills, but you'll likely save money into the bargain. When it comes to electronics and making your own tech gear, it might seem pretty daunting at the beginning, but getting yourself a toolkit and learning how and when to use it is a good place to start. What's more, it won't cost you a fortune. Here's what you need.**

## DIGITAL MULTIMETER

No electronics toolbox can do without a digital multimeter or 'DMM' for short. A DMM is used primarily to measure voltage across a component, the current in series with a component and the resistance of a component. Almost every DMM will do this much, but what separates them is the extras they can include. Ideally, you want one that's auto-ranging — that means it automatically adjusts the scale to read the correct voltage, current or resistance you're trying to measure (cheaper units rely on you setting the correct range). Get bonus points if it can read 'true RMS' voltage (many budget DMMs can't) — this will be useful if you plan on doing audio projects, less important for robots. The ability to read frequency and capacitance is good to have whatever you do and if it has a backlit display, even better. Jaycar's budget QM1321 is worth a look at $34.95.

## HAND TOOLS

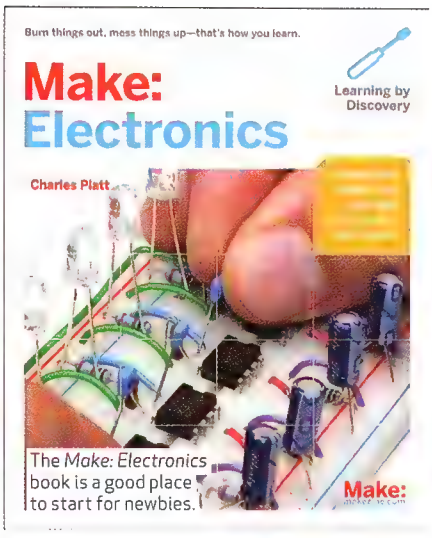
You'll find you won't get far without the right hand tools either. At minimum, you should have a pair of needle-nose pliers for bending and straightening component wires and component legs, plus a pair of side-cutters for cutting wire, component legs and whatever else. A pair of wire strippers for removing the insulation around wire cabling without cutting the inner wire conductors can also be useful. Jaycar has a basic five-piece pliers/cutters set for $30 (Cat. TH1812).




This 400-point breadboard is a great way to prototype your projects.

A Digital Multimeter is a must for almost all electronics work.

This five-piece pliers and side-cutter set from Jaycar will cost you $30.



The *Make: Electronics* book is a good place to start for newbies.

Screwdrivers are also incredibly useful to have on hand – for beginners, Bunnings has a 19-piece set by Craftright for $10 that includes flat-blade, Phillips-head and small precision screwdrivers. For basic hobby work, it should be fine.

## BREADBOARD AND WIRES

You'll notice that many of the projects we build in our Arduino Masterclass (and sometimes in our Raspberry Pi Masterclass) are made on breadboards, plastic boards with holes spaced on a 0.1-inch grid. They're great for prototyping (first-time builds), as well as learning because, provided your components are all pre-soldered, you don't need to solder anything. There are three sizes I use all the time – the tiny 170-point breadboards are perfect for DigiSpark and Arduino Nano projects, the 400-point boards for adding more components, while the larger 830-point breadboards give you plenty of space to add and experiment. What's more, they're cheap enough to be a viable alternative to making circuit boards yourself.

To make connections, grab some 'dupont wires' – these are wires with breadboard pins on either end, known as 'male to male'. They come in lengths of 10, 20 and 40cm. Grab some 10cm male-to-male wires on eBay for around $2 for 40 pieces.

## POWER

If you're coding your own micro-controller boards like the Arduino, ESP8266 or STM32 series, these can be powered directly by USB, which can come from your laptop or PC. But when your project is finished, external power is the go. Assuming your project is complete and working, you can choose USB phone chargers or battery power banks – you'll generally find these at retailers starting for around $10 each. Just be sure to understand your project's power needs and don't overload your power source.

## MODULES

However, the fun really starts with the mass of pre-built modules you can find on eBay – everything from voltage regulators to digital-to-analog converters to environmental sensors for anything and everything. Think of a project idea and chances are there's a module that can help bring it to fruition. Think of it as the electronics version of Lego.

An easy way to start is with an 'Arduino Sensor Starter Kit'. These sell on eBay for around $40 and include up to 40 different sensors for measuring and recording light, sound, magnetic fields, flame, heartbeat and more. Remember, these need an Arduino microcontroller board, as well as library code to make work, but they can be a lot of fun.

## BOOKS

If you're learning electronics only from the internet, take extreme care. There is some good stuff online, but there's also a good amount of rubbish and it can be difficult to pick the difference if you're not experienced. That's why I still recommend good old-fashioned books – a good reference text will guide your learning in a systematic way and help everything come together and make sense.

If you are a genuine newbie, Charles Platt's *Make: Electronics* is a good start – you can get the first 49 pages free as a sampler online from **tinyurl.com/ybd835bw** (PDF). It may look a little quaint these days with its hand-written style, but Forrest Mims III's *Getting Started in Electronics* sparked many an engineering career in the 1980s and '90s. It's still a fun read and available online.

If you're after some deep learning, *The Art of Electronics* by Paul Horowitz and Winfield Hill is an excellent practical textbook – you can get an idea of its depth by reading Chapter 9 free from the publisher's website at **tinyurl.com/ycm8gdyv** (PDF). However, for some serious mind bending, try *Microelectronic Circuits* by Sedra and Smith. This was one of the core textbooks during my electronics degree and is now in its 7th edition. It's one of the most popular electrical engineering textbooks written, but it's pretty heavy on the maths and theory, so if that's not your bag, go with *The Art of Electronics* instead.

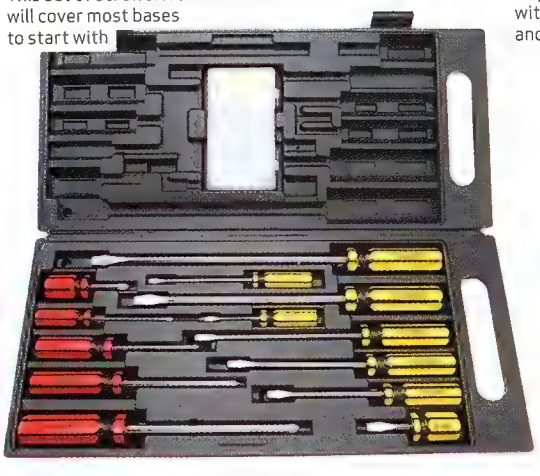
## THE ARDUINO IDE

Finally, if you're planning on making your projects 'smart', you'll need the Arduino integrated development environment (IDE) software. It comes loaded with examples, so provided you have a basic Arduino Nano or Uno board, you'll be able to get started and learn to code. Grab it free for Windows, macOS and Linux from **arduino.cc/downloads**.

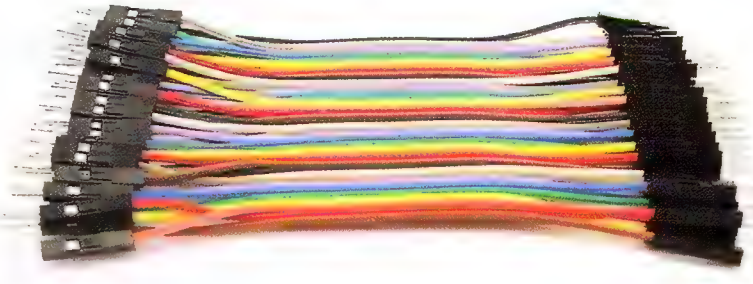
## LIFE-LONG LEARNING

Technology today is driven by electronics, software development and AI. Grab any combinations of those skills and chances are you'll never be short of job offers. Still, the key to long-term success is being a life-long learner – technology development never stops, so your learning can't either.

This set of screwdrivers will cover most bases to start with



Dupont wires make working with breadboards nice and easy.



# Predicting survivors of the Titanic disaster using AI

Machine learning can be applied to many tasks, including predicting the survivors of the Titanic. Darren Yates shows how to code a solution online using Python on Kaggle.

**Machine learning can feel like a hard nut to crack at first. Its combination of computer science, statistics and mathematics can seem impenetrable. Yet, it's like any skill – you have to start slow, learn the basics and just start doing it. The more you do it, the better you get at it. The machine learning online community is growing constantly and there are plenty of good resources available to help speed up your journey. This month, we're combining two of those resources – the online platform Kaggle, plus the popular Python programming language, to try and predict the survivors of the Titanic.**

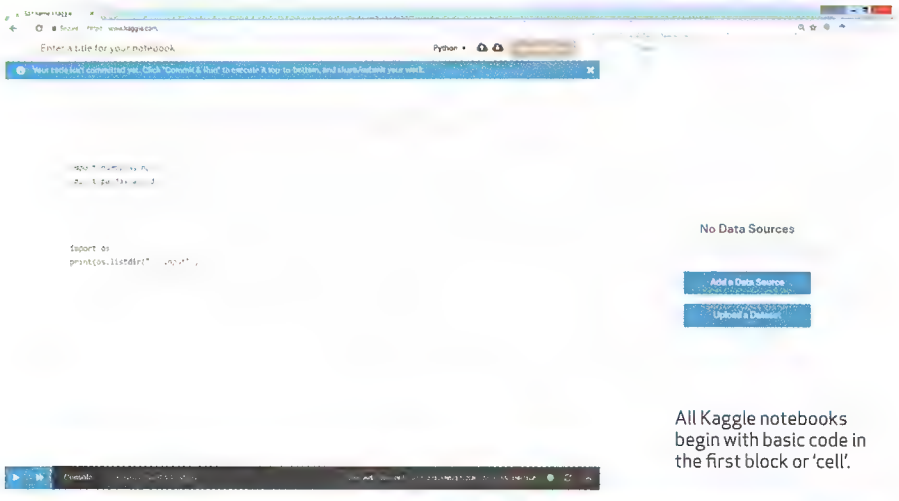
## KAGGLE

The boom in machine learning has seen numerous data-mining communities spawn in the last decade and Kaggle is probably the largest. What makes Kaggle that little bit special is that it started in Melbourne in 2010. It was also one of the first to crowd-source competitions – they offer prize money for the most accurate model that summarises the relationships within data supplied by third-parties.

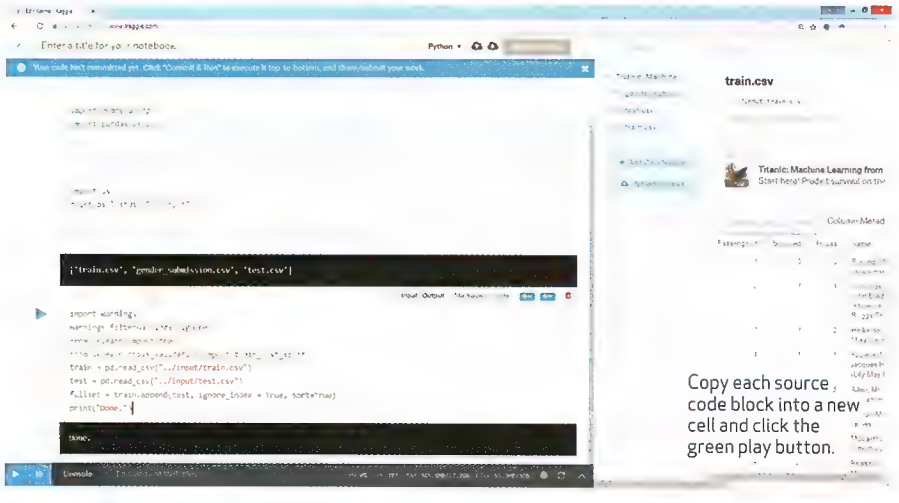
However, Kaggle also offers some interesting learning competitions that anyone can enter. The one we're getting involved with this month is predicting the survivors of the Titanic. The story of the sinking of the world's most famous ship on its maiden voyage from Southampton to New York with the tragic loss of 1,500 passengers and crew is well known. The Kaggle competition 'Titanic: Machine Learning from Disaster' (**www.kaggle.com/c/titanic**) aims to use machine learning to predict which passengers survived the Titanic. There's no prize money, but it's still a great introduction – what's more, there's lots of help available at **kaggle.com/c/titanic#tutorials**.

## THE TASK

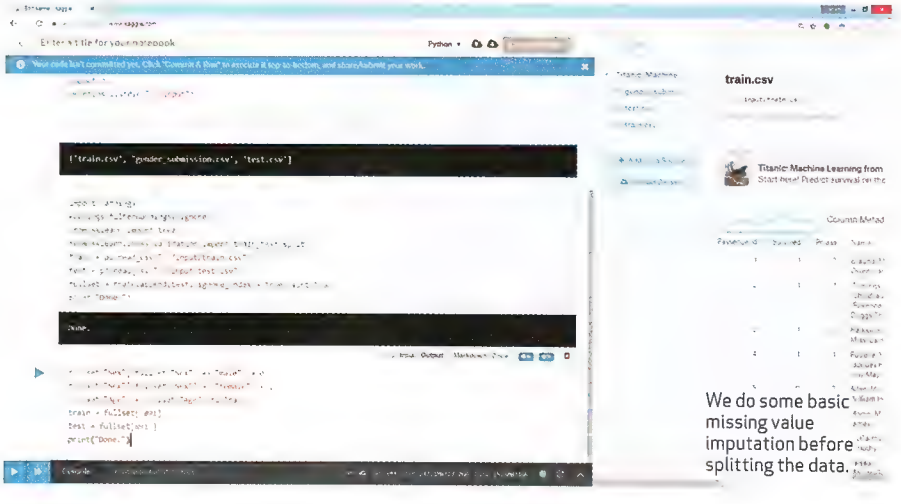
Our task is to create a set of rules or 'model' learned from a set of data called the 'training' dataset, then test that



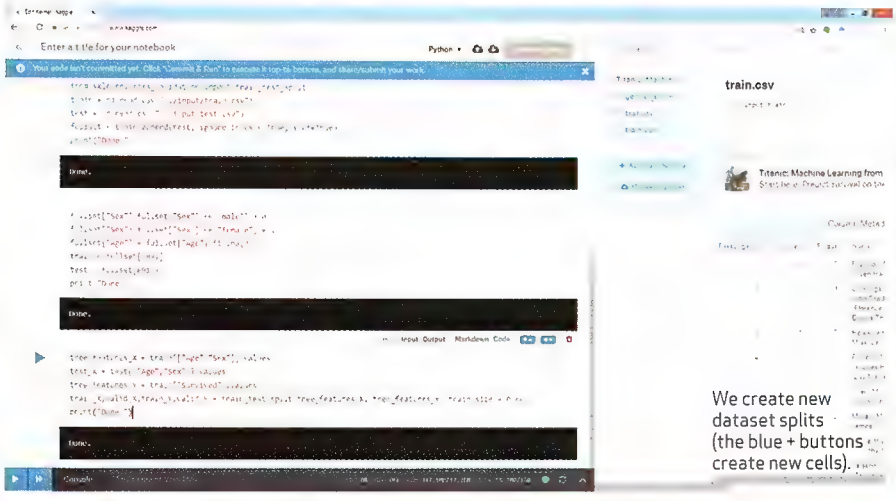

All Kaggle notebooks begin with basic code in the first block or 'cell'.

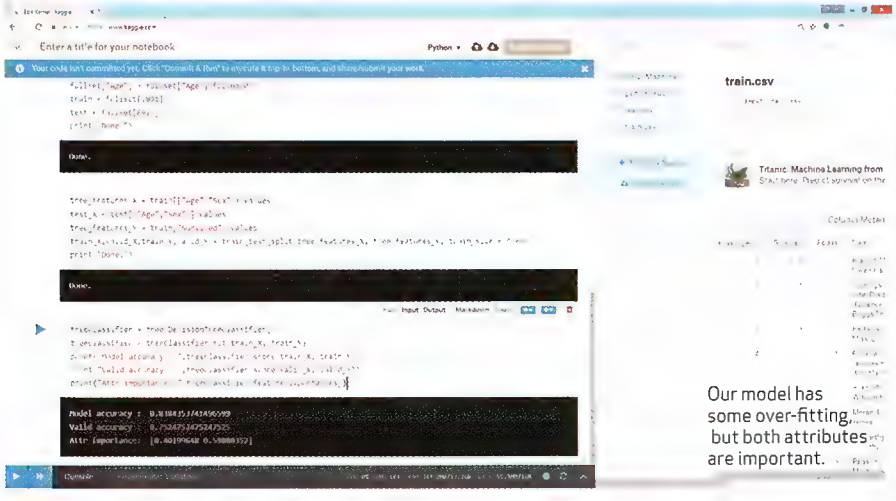



Copy each source code block into a new cell and click the green play button.




We do some basic missing value imputation before splitting the data.




model against a second set of data called the 'test' dataset. The goal is to see how accurately we can predict which of the passengers in the 'test' dataset survive the Titanic using just machine-learning. We then upload the model's prediction results to Kaggle's leaderboard to see how well we did.

However, rather than use the Weka data-mining app we've looked at previously, we're building this model from scratch on the Kaggle website itself using the Kernel Notebook.

## GETTING ON KAGGLE

To take part in this competition, you need to sign up to Kaggle – it's free with no ongoing costs. Once you've signed up, you'll see a menu list across the top. Click on Kernels and when the Kernels page appears, click on the 'New Kernel' button near the top-right of screen. This will allow you to create a machine learning script Kaggle calls a 'kernel'. You'll now get the choice of two kernel types – Script or Notebook. A 'script' executes once top to bottom, whereas a 'notebook' is a collection of mini-scripts or 'cells' you can run individually. Select 'notebook'.

## LOADING TITANIC DATASETS

The Notebook editor gives you two main panels initially – a large code editor on the left and control panel on the right with tabs for data, settings and versions. First up, we need to grab the two Titanic datasets, so click on the 'Add a Data Source' button on the right and when the Add Data Source window appears, type 'Titanic' into the search bar, click on the Competitions menu option, then select the 'Titanic: Machine Learning from Disaster' entry. This brings you back to main Notebook editor window, with the datasets now listed. Click on the 'train.csv' file in the Data tab and you'll get a file summary, including the filepath '../input/train.csv'. You use this filepath to import the dataset(s) into your code.

## WHAT WE'RE DOING

There are any number of ways to write an algorithm to determine the survival of passengers in the 'test' dataset, but to keep things manageable, we'll work our way through a simple implementation that gives reasonable results. Once the algorithm is complete, we'll create a CSV file with two columns – passenger ID and their survival state (1 = saved, 0 = not) – and submit that to the Kaggle Titanic competition and see how we do.

## IMPORTING DATASETS

Because Kaggle Notebook allows you to execute your code in stages, that's what we'll do and the first step is to import the various Python libraries we'll need, plus the train.csv and test.csv datasets, as well as combine those datasets into a single global set. Copy this code into the second cell:

```
  import warnings
  warnings.
filterwarnings('ignore')
  from sklearn import tree
  from sklearn.cross_
validation import train_test_
split
  train = pd.read_csv("../
input/train.csv")
  test = pd.read_csv("../input/
test.csv")
  fullset = train.append(test,
ignore_index = True,
sort=True)
  print("Done.")
```

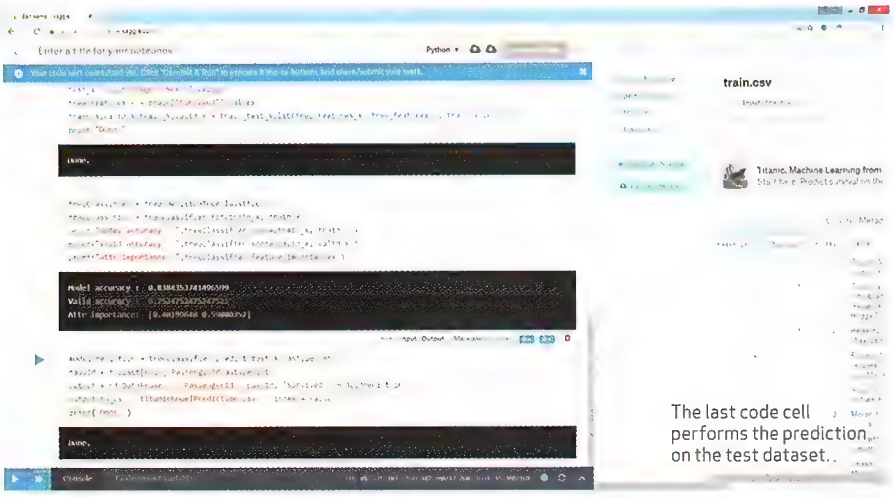
To run a Notebook cell, click inside the cell, a green 'play' button appears in the left-side boarder. Click it and the cell code runs. For the code above, the first two lines import the 'warnings' library and turns off the warning messages that pop up fairly often. The 'sklearn' library is Python's excellent scikit-learn library that provides mountains of machine-learning tools. The two we import are the Decision Tree (tree) function and the 'train_test_split' function from the 'cross validation' sub-library. After that, we read the train.csv file into a dataframe called 'train' and the test.csv file into a dataframe called 'test'. A dataframe is two-dimensional list or array much like a spreadsheet that can contain lists of data of different types, for example, a list of ages (integers) and a list of days of the week (strings).

Once loaded, we want to combine these datasets into one complete dataset to make it easier to fix or 'clean' the data, so we append the 'test' dataframe to the 'train' dataframe and store it in a new dataframe called 'fullset'. When that's done, we print 'Done.' to the screen, as Notebook cells don't give obvious indication when they're complete.

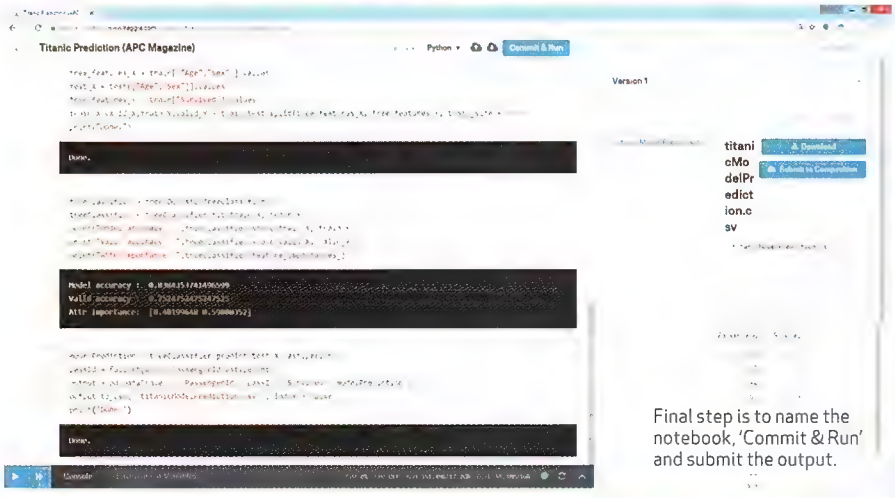
## DATASET ATTRIBUTES

We've mentioned it before, but just to recap, a dataset is typically a spreadsheet, where the rows are independent events and the columns are features or 'attributes' of those events. If we look at the train.csv dataset, each row is a passenger and you'll see there are 12 attributes:

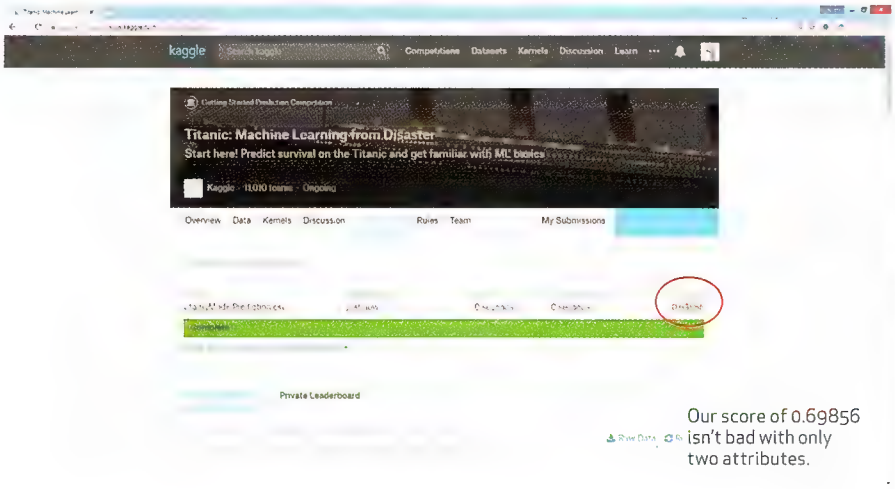
- PassengerId – the identifier of the passenger
- Survived – the class attribute,



The last code cell performs the prediction on the test dataset..



Final step is to name the notebook, 'Commit & Run' and submit the output.



Our score of 0.69856 isn't bad with only two attributes.

identifies if the passenger survived (1) or not (0)
- Pclass – the class of fare purchased by the passenger
- Name – the passenger's name
- Sex – the passenger's gender
- Age – the passenger's age
- SibSp – the number of siblings or spouses also on-board
- Parch – the number of parents or children also on-board
- Ticket – the passenger's fare ticket number
- Fare – the price paid for travel
- Cabin – the passenger's cabin number
- Embarked – location at which the passenger boarded

The first thing you'd do now is perform some preliminary tests to try and identify which of these attributes may help in determining the survival of passengers. However, since we're short on space this month, we'll just cut to the chase. It's well known that a predominant number of women and children were rescued, so we know the 'Sex' and 'Age' attributes will be important factors. But in order to use the Decision Tree classifier to test our theory, we need to convert the values of the 'Sex' attribute from string or 'categorical' into numerical.

Another significant issue we need to consider on an attribute-by-attribute basis is missing values. Books have been written on 'missing value imputation' and here, we need to handle the records that have no 'Age' value (the passenger's age was not known). We're going to take a very simple option and just give them an age of zero. So, with all of that, here's our next code block:

```
  fullset["Sex"][fullset["Sex"]
== "male"] = 0
  fullset["Sex"][fullset["Sex"]
== "female"] = 1
  fullset["Age"] =
fullset["Age"].fillna(0)
  train = fullset[:891]
  test = fullset[891:]
  print("Done.")
```

We set 'male' values of attribute 'Sex' to zero and 'female' values to '1'. Then, we use the 'fillna' function to give any record with a missing value for 'Age' the value of zero. After that, we split the full dataset back into the train and test sets and we're done. Remember to run each code block to see what it does.

## SEPARATE ATTRIBUTES

Now we need to select our attributes to test. So first, we set up two dataframes, tree_features_X and test_X, to store the non-class attributes from the 'train' and 'test' datasets, respectively, that we think are important – namely, Age and Sex. Next, we create a separate dataframe for the 'survived' class attribute called 'tree_features_Y'.

Now comes the tricky part – we want to split the tree_features_X and tree_features_Y dataframes into two. We'll create train_X and train_Y, plus valid_X and valid_Y. Why? We want to pre-test how accurately our model can predict the survival outcome just from the training dataset, so we need to split the training set (train.csv) into two groups – the train_X and train_Y dataframes contain the records we'll build our model from and the valid_X and valid_Y dataframes contain the records we'll use to test or 'validate' our model with. Two-thirds (0.66) of the records go into the train_X/Y sets and the rest into the valid_X/Y sets. The code for this goes into another Notebook cell:

```
  tree_features_X =
train[["Age","Sex"]].values
  test_X = test[["Age","Sex"]].
values
  tree_features_Y =
train["Survived"].values
  train_X,valid_X,train_Y,
```

```
valid_Y = train_test_
split(tree_features_X, tree_
features_Y, train_size = 0.66)
  print("Done.")
```

## BUILD THE DECISION TREE

The validation step works by testing the model learned from the train_X/train_Y sets with the valid_X/valid_Y sets. It compares the survival values the model predicts for each record in the valid_X set with those actual values in the valid_Y set to see how many we get right. If we get it 100% right, we score 1.0000. Now that we've created the datasets with just the attributes we're interested in, we're ready to build our decision tree and validate it. This is done by creating a new Notebook cell and adding the code:

```
  treeClassifier = tree.
DecisionTreeClassifier()
  treeClassifier =
treeClassifier.fit(train_X,
train_Y)
  print("Model accuracy :
",treeClassifier.score(train_X,
train_Y))
  print("Valid accuracy :
",treeClassifier.score(valid_X,
valid_Y))
  print("Attr importance:
",treeClassifier.feature_
importances_)
```

The first line creates a Decision Tree classifier called 'treeClassifier', then we use the 'fit' function to build a tree from the non-class attributes in train_X and the class values in train_Y. The final three lines then print out the classification accuracy results, first for the train_X/Y sets. Next, we apply the decision tree model to the valid_X and valid_Y sets and print out the validation accuracy score. The last line prints out the respective importance values for each attribute used to build the tree. If an attribute has a score of 1.000, it is vitally important to the tree; if the score is 0.000, it's completely irrelevant.

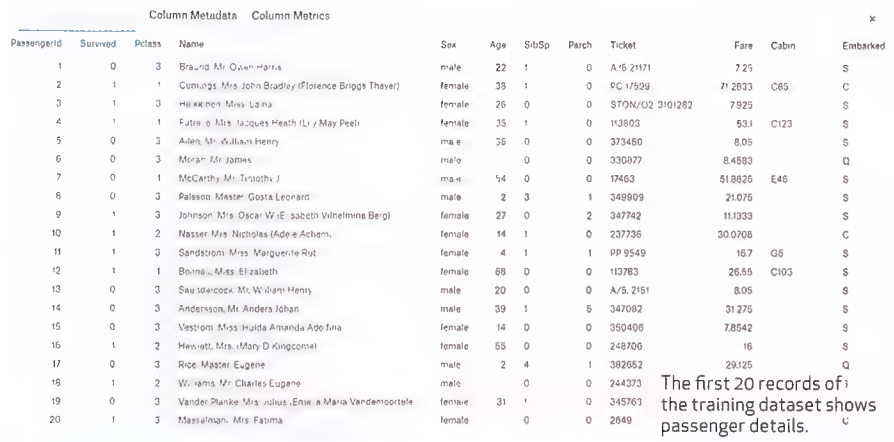
## MODEL VS VALIDATION ACCURACY

Why two scores? If the model accuracy score is much higher than the validation accuracy score, it means that the decision tree model we created is too specific to the training data or 'over-fitted'. Here, our model accuracy is 0.8384, but our validation accuracy is only 0.7524 – that means we have some overfitting, so the model won't handle as well new records it hasn't seen before. Still, a validation score of 0.7524 from a tree with just two attributes isn't a bad start.

However, now its crunch time – we have to run the original test.csv passenger records that have no survival data through our decision tree model and see how accurately we can predict survival using nothing but machine-learning. Once we do that, we create a separate CSV output file we submit to the Kaggle Titanic Competition and see how well we went. So, the last set of code we need to enter into a new Notebook cell looks like:

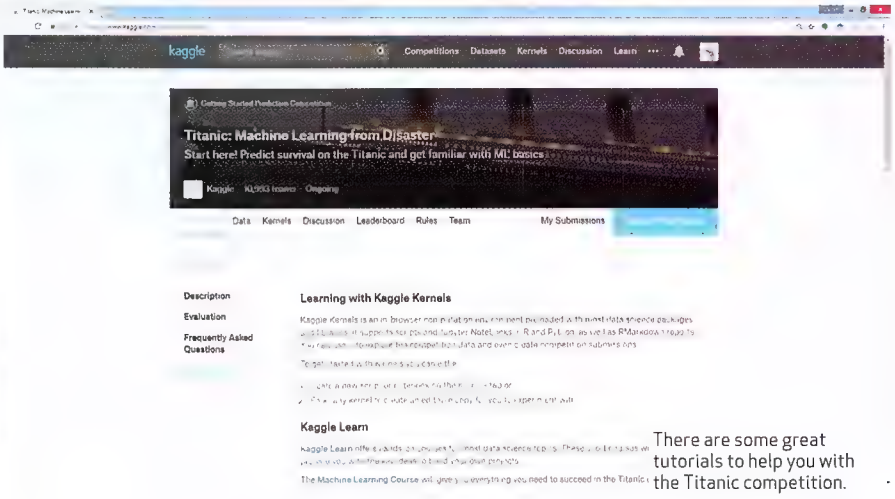
```
  modelPrediction =
treeClassifier.predict(test_X).
astype(int)
  passId = fullset[891:].
PassengerId.astype(int)
  output = pd.DataFrame( {
'PassengerId': passId,
'Survived': modelPrediction }
)
  output.to_csv(
'titanicModelPrediction.csv' ,
index = False )
  print("Done.")
```

The first line creates a dataframe called 'modelPrediction' and fills it with the predictions for the records in the 'test_X' set written as integers (int). Next, we write the passengerId values into another list called 'passId'. After that, we create a dataframe called 'output' with two columns – the passenger IDs and the corresponding predictions for those passengers. Finally, we write this to a file called 'titanicModel Prediction.csv'.



| PassengerId | Survived | Pclass | Name | Sex | Age | SibSp | Parch | Ticket | Fare | Cabin | Embarked |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 3 | Braund, Mr. Owen Harris | male | 22 | 1 | 0 | A/5 21171 | 7.25 | | S |
| 2 | 1 | 1 | Cumings, Mrs. John Bradley (Florence Briggs Thayer) | female | 38 | 1 | 0 | PC 17599 | 71.2833 | C85 | C |
| 3 | 1 | 3 | Heikkinen, Miss. Laina | female | 26 | 0 | 0 | STON/O2. 3101282 | 7.925 | | S |
| 4 | 1 | 1 | Futrelle, Mrs. Jacques Heath (Lily May Peel) | female | 35 | 1 | 0 | 113803 | 53.1 | C123 | S |
| 5 | 0 | 3 | Allen, Mr. William Henry | male | 35 | 0 | 0 | 373450 | 8.05 | | S |
| 6 | 0 | 3 | Moran, Mr. James | male | | 0 | 0 | 330877 | 8.4583 | | Q |
| 7 | 0 | 1 | McCarthy, Mr. Timothy J | male | 54 | 0 | 0 | 17463 | 51.8625 | E46 | S |
| 8 | 0 | 3 | Palsson, Master. Gosta Leonard | male | 2 | 3 | 1 | 349909 | 21.075 | | S |
| 9 | 1 | 3 | Johnson, Mrs. Oscar W (Elisabeth Vilhelmina Berg) | female | 27 | 0 | 2 | 347742 | 11.1333 | | S |
| 10 | 1 | 2 | Nasser, Mrs. Nicholas (Adele Achem) | female | 14 | 1 | 0 | 237736 | 30.0708 | | C |
| 11 | 1 | 3 | Sandstrom, Miss. Marguerite Rut | female | 4 | 1 | 1 | PP 9549 | 16.7 | G6 | S |
| 12 | 1 | 1 | Bonnell, Miss. Elizabeth | female | 58 | 0 | 0 | 113783 | 26.55 | C103 | S |
| 13 | 0 | 3 | Saundercock, Mr. William Henry | male | 20 | 0 | 0 | A/5. 2151 | 8.05 | | S |
| 14 | 0 | 3 | Andersson, Mr. Anders Johan | male | 39 | 1 | 5 | 347082 | 31.275 | | S |
| 15 | 0 | 3 | Vestrom, Miss. Hulda Amanda Adolfina | female | 14 | 0 | 0 | 350406 | 7.8542 | | S |
| 16 | 1 | 2 | Hewlett, Mrs. (Mary D Kingcome) | female | 55 | 0 | 0 | 248706 | 16 | | S |
| 17 | 0 | 3 | Rice, Master. Eugene | male | 2 | 4 | 1 | 382652 | 29.125 | | Q |
| 18 | 1 | 2 | Williams, Mr. Charles Eugene | male | | 0 | 0 | 244373 | 13 | | S |
| 19 | 0 | 3 | Vander Planke, Mrs. Julius (Emelia Maria Vandemoortele) | female | 31 | 1 | 0 | 345763 | 18 | | S |
| 20 | 1 | 3 | Masselmani, Mrs. Fatima | female | | 0 | 0 | 2649 | 7.225 | | C |

The first 20 records of the training dataset shows passenger details.




There are some great tutorials to help you with the Titanic competition.

## SUBMITTING TO THE TITANIC COMPETITION

Once you've seen the final 'Done.' message, we're almost there – all that's left to do is give your notebook a title at the top-left of screen, press the 'Commit & Run' button and your code will run from top to bottom. When it completes, you'll see Version 1 appear on the right-side tabs and underneath, a new horizontal menu with the Overview results shown. Click on the 'Output' menu item and the titanicModelPrediction.csv output appears. Next to it, you'll see a 'Submit to Competition' button. Press it. This will automatically submit your output csv file to the competition and after a few seconds, you'll see your score on the leaderboard. The public leaderboard scores are calculated by Kaggle using only half the test dataset, so they won't be the same as you'll calculate. Our score is 0.69856 – not bad for a tree built using just two attributes. We'll come back to this next time, but in the meantime, have a go yourself! We'd love to hear how you get on. ■

# downtime

» CARMEL SEALEY LEVELS UP AND HEADS ONLINE TO FIND OUT THE LATEST IN GAMING NEWS

## Typo in Aliens: Colonial Marines code may explain dodgy AI

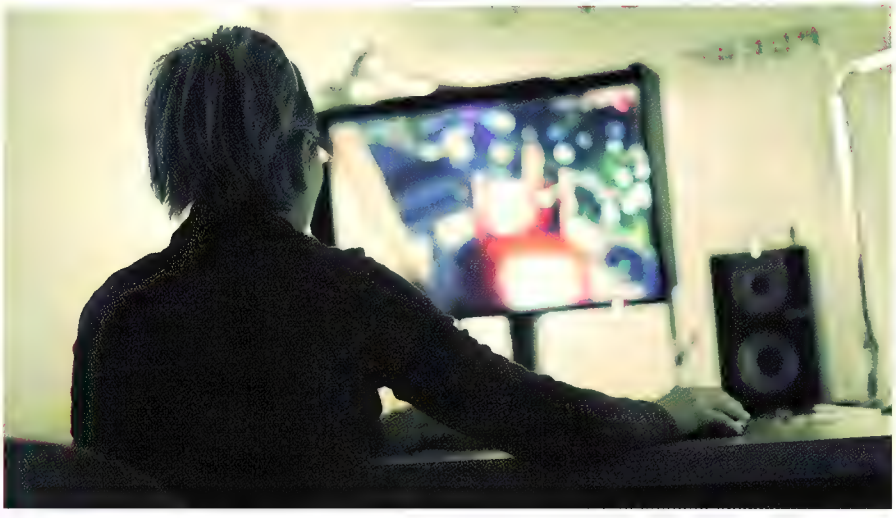
**BUT DOESN'T REDEEM IT ENTIRELY.**

Five years after the game was released, a discovery in one of the game's .INI files could go some way to explaining why *Aliens: Colonial Marines*' AI was so, well, crap. Poster JigglesBunny on gaming forum Resetera first revealed the typo — a rogue 'a' in some code — and theorised that it was this tiny mistake that could have caused the dodgy AI. This turned out to be only partially correct, but was enough to prompt developer Gearbox to post a job ad for a Programming Copy Editor to hopefully prevent this from happening again.

## Microsoft no longer has plans for Xbox VR support

**GOULD HAND OF PROKEN VR DREAMS.**

Despite the fact that Microsoft promised that it would support virtual reality on its popular Xbox One console, it has recently informed GamesIndustry.biz that this is no longer the case. Oh, and if you were holding out for mixed reality support, there's similarly disappointing news on that front. By way of an explanation, Microsoft's CMO Mike Nichols said that the company's "perspective on it has been and continues to be that the PC is probably the best platform for more immersive VR and MR." Oh, well.



## New research reveals core gamer types

### Could be reflected in future games designs to deliver a more personalised experience.

**A research team at the University of Waterloo has been exploring the science behind what motivates gamers to keep playing. On top of a selection of player archetypes that were determined — including survivor, seeker, mastermind, daredevil, conqueror, achiever and socialiser — the team claimed that there were three different 'traits' that could make it possible "to analyse player preferences for different groups of people", such as age brackets or gender. These traits reflected namely whether the player preferred action elements, the game's visual aesthetic or its in-game goals and story.**

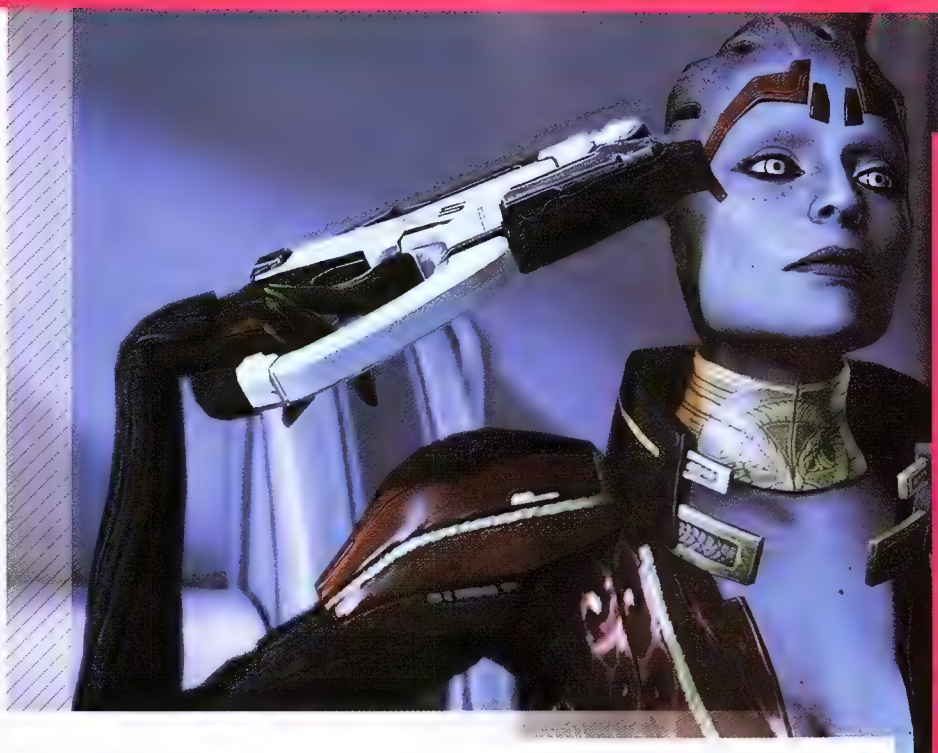
According to co-author Gustavo Tondello, while the results of the study could obviously help game developers and designers fashion titles to cater to gamers' preferences (and, therefore, effectively motivate gamers to play them), the results could also extend beyond the gaming sphere. "We can create systems that are more pleasant to use," he explained in a press release, "and help people feel more engaged and motivated to achieve their goals." Sounds good to us!

## Are our games spying on us?

**RED SHELL TRACKER SNEAKS INTO TOP TITLES.**

Do you expect your games to send marketing information gathered from your online activity to a third party? Of course not. So when gamers found that the spyware Red Shell was bundled with their Steam games, there was an online uproar. The list of titles featuring the unwanted extra runs to over 50, including *Civilization VI*, *Elder Scrolls Online* and *Conan Exiles*. The online backlash has prompted many publishers to remove it, and others have promised to.

Red Shell (yes, a *Mario Kart* reference) is a marketing tool to track the effectiveness of adverts; it watches to see whether you visit marketing campaigns on Facebook, Twitter and the like (only while the game is running). No personal data is collected, and nothing sold on. However, it tracks online activity without express permission — *naughty, naughty*. Having your data harvested by a free game may be an acceptable part of the deal, but when you've laid out cold hard cash, you expect better than this. **Chris Lloyd**



# Parents may not be as strict about games ratings as they are with movie ratings

## UK study reveals intriguing insight.

After studying over 2,000 parents from across the UK, the Childcare.co.uk survey has revealed some interesting habits among parents of gamers aged between 5 and 15. According to the study, 86% of parents admitted they do not pay attention to age restrictions on games. "What's interesting is that the majority of parents follow film age ratings, but when it comes to video games, they maybe aren't as strict," commented Richard Conway, founder of Childcare.co.uk. The study also looked into subsequent changes in behaviour, with 43% of parents reporting a negative change in their child's behaviour after playing games aimed at adults, while 22% stated their children now understood or used bad language.

The survey comes at a time when games are once again under the microscope regarding how they impact children, with the massive popularity of *Fortnite* amongst kids resulting in the game catching heat in the mainstream media. What the study unfortunately doesn't reveal are the reasons why parents are not as strict with games as they are with films. We reckon it might be down to the naïve mentality that some parents of gamers still hold: that all games are for children, whereas films are more 'mature'.

### Concern over the effects of Fortnite on children is "excessive", claims expert

**WHILE AUSTRALIAN SCHOOLS ISSUE ADVICE TO PARENTS, WARNING OF ITS "NEGATIVE EFFECTS".**

Whether it's *Overwatch, PUBG, Fortnite* or whichever big game will come next, there will always be the same media uproar when children begin to show a change of behaviour at school or home due to gaming. According to *The Guardian*, several Australian schools have issued newsletters to parents, stating that *Fortnite* is responsible for altered behaviour during lessons and in the playground, but also warning that its highly online-interactive nature could result in bullying.

Dr Marcus Carter from the University of Sydney, however, believes that this concern could be somewhat "excessive". "The media panic around *Fortnite* is indicative of tensions that exist between parents, children and any new media," he said. "Parents can quite rightly not want their kids playing with adult strangers online [but] digital gaming on its own, is not bad." He said the best solution for worried parents was to sit down with their children and play the game with them, to make up their own mind.

### Dead or Alive 6 is toning down the sexiness

**FEMALE CHARACTERS GET SOMETHING OF A MAKEOVER.**

According to an interview conducted by GameInformer, director Yohei Shimbori shed some light on the new designs for the game's female cast. "For this version, we still have Kasumi with her previous costumes," he said, "and there are some parts that are going to jiggle or move, but we want to make it a lot more natural." The franchise has been criticised in the past for its emphasised breast physics, so this time around, Shimbori wanted to let the characters' "strong personality" shine instead. However, he also wanted to make clear that, while they were toning down the sexiness, "for downloadable content, we have to see what gamers really want."

### High School League of Legends Australian & New Zealand Championship launches

**NZ LEAGUE JUMPS ACROSS THE TASMAN.**

The league has already gained a firm foothold in NZ, but now, thanks to a permit awarded by Riot Games, that league is set to include teams from around Australia as well. The popular MOBA has already spawned multiple competitive esports tournaments around the world, and this latest league is set to kick off at the end of July and run through until September. The competition professes to promote resilience, cooperation and leadership skills, while also giving students the chance to form new friendships, all while playing computer games. Sounds perfect! ■

apc HOT PRODUCT

PC, PS4, XO | $30 | WWW.EA.COM/GAMES/UNRAVEL

# Unravel Two

## Sit down and have a good yarn with a friend.

**We admit that we never actually played the first *Unravel* when it came out back in 2016, but if you're in the same boat as your humble reviewer, then you needn't worry — *Unravel Two* stands up on its own woollen feet.**

Couch co-op games are few and far between these days, so we were eager to give this one a whirl, especially as some of the platforming puzzles on offer actually rely on two distinct characters doing separate things. No, that doesn't mean you *have to* play with a friend, but the experience is definitely more rewarding if you do.

Playing in single-player mode gives you control over both the familiar anthropomorphic Red Yarny (who now has a different shaped head) and his new friend Blue Yarny (although you can change the appearance of both if you wish), who are connected to each other Avatar-style after both their balls of wool get broken in a storm on the high seas.

In both modes, the two Yarnys can connect into one — which is useful in single-player, as they otherwise can only be operated individually.

The story setup for this sequel is minimal and the narrative that runs along in the background can be mostly ignored, but that's nothing to worry about, as the puzzles and environments will have you gripped from the get go.

The visuals in this game are hauntingly beautiful, making the most mundane environments seem epic, dangerous and dazzling. The game begins with the two characters finding their way — with the help of a sprite — through a storm-drenched forest and underground stream, and the puzzles will see you pushing broken branches across the floor to create steps, wall-jumping, swinging from ledges, clambering up vines and bouncing around the walls of a well. The game soon brightens once you're above ground and you'll soon be traversing warehouse floors, getting shot out of steamy pipes, fleeing from fire and scurrying across grassy gardens.

The puzzles become more challenging, too, and will see you fashion bridges to drag objects to where you need them, haul your buddy up cliff faces, use your yarn as a bungee rope (think *Worms*), and also utilise your woolen connection as an acrobatic, winding leverage system to get first one Yarny and then the other across an otherwise uncrossable chasm. The knotted wool that connects the characters is a useful lifeline, but stray too far from each other and they'll begin to unravel and eventually snare, making sure your co-op buddy doesn't get too far ahead. It encourages co-op every step of the way and it's definitely the better way to play the title. In all, it's thoroughly enjoyable gameplay and surprisingly diverse, given you're literally only working with a piece of string.

At the end of the day, *Unravel Two* comes highly recommended from us, whether you've got friends to play with or not. It's a great game, encouraging us to go back and visit the original.

■ Carmel Sealey

### Verdict

**Enjoyable gameplay paired with stunning visuals — everything a good platformer should be.**

★★★★★

Exotic street cars are back, but you'll spend more time on the dirt or in the air.

PC, PS4, XO | $99.95 | THECREW-GAME.UBISOFT.COM

# The Crew 2

## Open-world online racer fails to improve on its predecessor — but is a blast nonetheless.

**As is often the case with blockbuster online games, 2014's *The Crew* had a disappointing launch but, over the years to come, blossomed into something great. Fingers crossed this is the trajectory for its sequel, because at launch, it's a decent racing game but it lacks flair.**

Ubisoft has wisely opted to avoid an edgy narrative this time around, choosing instead to layer a social media meta-game over the open world racing. As you travel this condensed United States, participating in races and tournaments, you'll gather social media followers, and the more clout you have, the more access you'll get to events and vehicle types. It's shallow and dumb, but no more so than *Forza Horizon*'s festival conceit, and so long as you mute the execrable voiceover guy, it's mostly unobtrusive.

With the removal of the Z-grade narrative and a fresh progression system to figure out, the opening hours are promising. In addition to road vehicles, you'll be racing motorboats and planes, and switching between the three seamlessly while exploring the open world is genuinely thrilling. But things start to wear: as for that open world exploration, it's redundant. This time around, you can simply select events on your map, eliminating any requirement to go out and explore the open roads. This serves to make *The Crew 2* feel like a series of thematically incoherent races, rather than the road trip its predecessor often felt like.

And while we're on the topic of the map: the UI in this game is clunky and confusing. On PS4 Pro, accessing the menu is excruciating thanks to long load times, and once you've done so, figuring out what races you've done and which are still open requires manual filtering. Easy enough, but tedious after a while, and it doesn't help that the game boots you into a first-person garage environment that... kinda just doesn't make any sense. Why are these vehicles, in particular, displayed?

The driving is great fun but the AI is supernaturally adept at catching you up at the faintest error on the player's part (rubber-banding, according to racing game connoisseurs), so races become less about pulling ahead of opponents, and more about not making a single minor error. When some major races run a total of 30 minutes, this can get stressful.

*The Crew 2* isn't a disaster, it's actually really fun. But it doesn't improve on its predecessor, and that's possibly a sequel's biggest crime. Updates will be forthcoming, and we're confident *The Crew 2* will become a much better game, but whether you jump in now or wait will depend on how patient you are.

■ Shaun Prescott

### Verdict

**What it lacks in polish it makes up for with scale. It isn't amazing, but updates will surely change that.**

★★★☆☆

## Red Faction Guerrilla Re-Mars-tered

### A smashing good time.

**PC, PS4, XBO | $49.95**
**WWW.THQNORDIC.COM**

Though its original form is almost 10 years old, *Red Faction Guerrilla Re-Mars-tered* has arrived on current-gen consoles and PCs with some resolution and framerate enhancements that serve to make the game's destructive architecture and enormous explosions all the more pleasurable.

Though its generic 'free Mars from an oppressive regime' storyline is forgettable, *Red Faction Guerrilla*'s sandbox gameplay, which sees you travel around various regions of the red planet in a rover taking on missions, is endlessly entertaining. Its driving and third-person cover-based shooting mechanics are robust, though the real fun comes in blowing up outposts held by the villainous Earth Defense Force (EDF) — even a decade later, this is still immensely gratifying

Minor framerate hiccoughs aside, this is as good as *Red Faction: Guerrilla* is ever likely to look on a console, and if you're a fan of the game from its original release (PC owners will find their game patched for free), we heartily recommend that you pick up this impressive remaster and get your ass to Mars again as soon as possible.

■ Stephen Lambrechts

★★★★☆

## Street Fighter 30th Anniversary Collection

Are you Ken?

**PC, PS4, XO, SWITCH | $79.95**
**STREETFIGHTER.COM**

Over the course of three decades, Capcom's stellar *Street Fighter* franchise has delivered numerous entries and iterations, each one improving upon the last in small but significant ways. With the release of the *30th Anniversary Collection*, almost every official 2D sprite-based entry has now been brought together in what can best be described as the ultimate historical package for long-time fans. Arcade-perfect versions of each game is included. Playing through each title again from the beginning brings to light the remarkable gameplay progression the series has made since its humble beginnings, particularly when it comes to the evolution of combos, super moves, cancels, parry moves, air blocking and more. On the presentation side, it's also fun to see how much the animation has improved over the years. Online play is also available for four of the titles, but we experienced some severe lag with the Nintendo Switch version in a number of instances. It's also a shame that only the original arcade version of *Alpha 3* is included. Still, there's no denying the wealth of content available here, and fans are sure to get a nostalgic rush while the many classic titles represented here.

■ Stephen Lambrechts

★★★★½

The circuits are strewn with ramps, and rarely a minute will pass when you're not hurtling through the air.

**PC, PS4, XO | $99.95 | ONRUSHGAME.COM**

# Onrush

## An stunt-oriented arcade racer unlike anything else.

**Onrush isn't really a racing game. Yes, it involves the driving of vehicles around circuits, but whether you're in front of, or behind, other vehicles doesn't really matter. In fact, being in front can be a huge disadvantage, because it means you'll have trouble destroying your enemies. But then, destroying other cars isn't (always) the point of the game either.**

The game is divided into four distinct modes, each of which feels like its own distinct game, and none of which require reaching any finish line first. The circuits are wide, vertically sweeping, and full of shortcuts and side passages, and the sense of speed is incredible. Especially when you're boosting, which is core to the competitive hook of most of the modes.

In order to gain boost, you'll need to destroy weak AI opponents which populate each race: think mobs in *League of Legends*. This is easy enough, but it's taking out (or otherwise avoiding) your direct opponents, whether AI or human, is the real challenge.

There's no finish lines, and being at the front of the pack is actually a disadvantage.

This isn't done with weapons; it's done with blunt metal-on-metal force.

This boost system plays into the most straight-forward mode, Overdrive, which tasks teams with using boost more than their opponent – whoever reaches the maximum amount of boost points first, wins the 'race'. There's also a checkpoint rush mode in the form of Countdown, a mobile hardpoint-style mode called Lockdown and Switch, an elimination mode where each player has only three lives.

There's a lootbox system but it's completely cosmetic, and there's no option to purchase anything with real money anyway.

Codemasters has obviously built this game with esports in mind, and while it's a huge amount of fun – probably the funnest car game we've played in years – it's still unclear whether it'll ever lend itself to spectator sports. Whatever the case, if you've ever complained about the dearth of arcade racers in modern gaming, this game is a nice little love letter to you. ■ Shaun Prescott

### Verdict

**An intense and gratifying car game where coming first doesn't mean anything.**

★★★★½

PC, PS4, XO | $69 | MADMIND-STUDIO.COM

# Agony

## Just painfully bad.

**Hell isn't meant to be nice. It's a cacophony of tortured souls – a place where every crunching step on the bones of the damned reveals even more torment. Aesthetically, there is no arguing with *Agony*. Design-wise, Madmind Studio's recreation of Satan's realm is a magnificent theatre of pain. However, when it comes to actually being a game, *Agony* falls flat on its suggestive toothy face.**

It's easy to see what this game was intended to be: a survival horror experience with stealth in the gory vein of *Outlast*. Unfortunately, it fails from the get-go. Landing in hell with no memory and an obsession with the 'Red Goddess', you must trudge onward into misery. The visuals deliver a sense of atmosphere at first, but progression is a slog. Puzzles involve nothing more than finding a series of internal organs, depositing them noisily in a bucket, and hoping you've got them all. Alternatively, you'll find yourself hunting for sigils, faintly glowing symbols scattered around the map, that you'll have to smear on gateways in the hope that you've got the right one.

Just to make these menial tasks even more frustrating, demons stalk you almost constantly. You'll find yourself running in the opposite direction until they get bored. Your soul can float around the map for a limited time after your demise, and you can possess other damned inhabitants if you've removed the hood from their face in advance. Die permanently, though, and you'll be back at the last 'soul mirror' with none of your progress saved. These checkpoints that happily vomit organs when you activate them are few and far between, meaning you can lose 45 minutes of progress from one attack by a spider demon made of arms. Great.

Then there's the not-insignificant fact that, for all the sources that the dev team has drawn on for its recreation of Hell, the only one they seemed to have bothered with for character inspiration is the deleted search history of a 14-year-old boy. *Agony* is obsessed with putting the 'tit' in 'titillation'. Between the design of its female demons and bad voice acting, cutscenes are both comedic and cringeworthy. Add in the bugs we experienced – everything magically sparkling on PS4 Pro, endless pop in, and screen tear – and *Agony* falls squarely into bargain bin territory.

And finally, it's important to address the horrific violence at work here. This is a game that often literally splashes about in human torment but manages to make it a complete snoozefest. The law of diminishing returns demands that, by the 50th screaming torture victim in an hour, you just won't care.

In a world where the most effective horror game of recent years is the looping corridor of a small flat, *Agony* fails to recognise that less is more. Leave it in the pit where it belongs.

■ Louise Blain

### Verdict

**Frustrating stealth sections, uninspired puzzling and dull action make *Agony* gaming hell.**

★½☆☆☆

## The Elder Scrolls Online: Summerset

### In the summertime!

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This latest expansion, together with recent updates, aims to create the most user-friendly MMO the industry has ever seen — a lofty goal but something it's somehow pulled off. *Elder Scrolls* melee combat is still awkward. We found an enchanted bow within an hour, and we're very glad to get it. Using this alongside offensive magic — a more viable option than in the offline games thanks to rapidly recharging magicka — the experience instantly becomes much smoother and more enjoyable. The isle of Summerset is a wonderful place to explore. Needless to say, it's also crammed full of things to do and see. The main story alone lasts several hours. The soundtrack deserves special mention, too — it's fantastic. *Summerset*, and the rest of the game, can now easily be played solo. That's just as well, really, as it's difficult to team up with others not on your friends list outside of structured raid-like missions, or the poor PvP. Behind-the-scenes matchmaking means that you can occasionally find yourself helping out one or two others for a few minutes in the middle of a quest. It's an MMO for people who don't like MMOs (that's a compliment).

■ Luke Kemp

★★★★☆

When pitching the game for a publisher, Virgin Interactive said it would take it, but only if it was adapted into a point and-click adventure

**DEVELOPER: DELPHINE SOFTWARE | PUBLISHER: DELPHINE SOFTWARE, US GOLD, INTERPLAY**
**RELEASED: 1991 | SYSTEM: AMIGA, ATARI ST**

GAME CHANGER

# Another World

It combined a cinematic world with a narrative-driven experience well before either concept was in vogue. To kick off our new monthly Game Changers series, we take a closer look at Eric Chahi's masterpiece.

**Developers are often asked a simple, but challenging question at the end of every interview: "Which game do you love most and why do you love it?" After all the gritty questions we journalists ask about their modern titles, it seems to be a fun way to end a conversation. A small handful of games keep popping up time and time again, and one of the most frequent and passionately supported of those is Eric Chahi's *Another World*.**

We've always had a deep appreciation of *Another World* here at *APC*, but, frankly, having read that so many developers love this game has made us re-examine the original Atari ST and Amiga release. Perhaps its most important contribution to the future of gaming was how cinematically minded it was. There's a sense of scene and place in the game unlike anything you would typically expect to find in an action adventure of this type. But this wasn't an interactive story with mild player participation. *Another World* is a fully featured, challenging and sometimes complex platformer and shooter. Its cinematic sensibility comes through its structuring and scene setting, rather than heavy-handed narrative or cutscenes. There's only enough story here to make sure you have motivation to move on to the next challenge and even then, none of it is spoken or written in words you could understand.

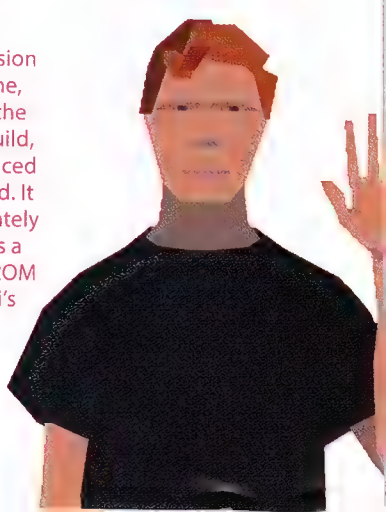
One of the great examples of this movie inspiration is how Chahi used the different planes of the 2D game to create depth. There are several sequences in which you see things moving in the background and foreground that help to establish this alien planet as a living place with action and entities all around you. You may only be able to move forward and backward, but the planet

## Key Facts

Lester's hair was red because Chahi wanted to make sure he didn't look like the rotoscoped footage he had recorded of himself.

A GBA version of the game, based on the Atari ST build, was produced but canned. It was ultimately released as a freeware ROM with Chahi's blessing.

The SNES release was lightly censored with the alien bums disguised in the bath house sequence.



exists in 360 degrees. And then it will play with you a little, giving you access to those planes of existence, such as sneaking behind a guard house when Buddy gets stopped by alien enforcers and taking them out from behind. Even something as simple as being able to walk up slopes and staircases that appear to be set behind your 2D plane added depth to the experience.

Structurally, also, *Another World* feels more like it's constructed into acts rather than into levels. The experience is continuous for a start, without level breaks or title cards, so you move from one area to the next, and often back and forth, without interruption. Each part of the game has its own feel and tone, too, as you search aimlessly and defenceless in the early stages of a strange and intimidating world, then you sneak and stealth your way around once you're armed and you close out the game in an all-out rush trying to escape. *Another World* was a game about story and experience, tone and mood, but not about scores, like so many games of its type from the era before.

In fact, *Another World* is completely without a HUD, which is pretty extraordinary even today. Not that it has a lot that it needs to tell you about exactly, but there's no map to the overworld, no indicator for your weapon when you finally get one and no health to speak of. It is incredibly challenging thanks to its single hit kill and threats all around you. Thankfully, the checkpointing was relatively generous so you wouldn't lose too much progress. And the game wasn't terribly long to play through either, which at the time of its release was a point of some criticism, but in the modern context seems relatively reasonable.

Part of the reason for the game's brevity is that it was a largely improvised development process for Chahi, who programmed and designed the game on his own for the most part. He has since explained that, in many ways, the structure began to reflect his own personal experience, as each chronological piece was built based on what he felt was the right direction to go in next. Lester Chaykin begins the game alone, much as Chahi was alone in development, then he meets Buddy and works with him, just as Chahi began to desire some companionship from the experience. Finally, Lester is exhausted, dragging himself to the final moments of the game, much in the same way that Chahi felt finishing the game, working 16-hour days for the last three months of development to get it all done in time. This freeform style of game-making goes some way to also explain why it took two years to make – pretty fast for a game these days. Chahi took the game where he thought it should go, building up the pace and tension of the experience as he went.

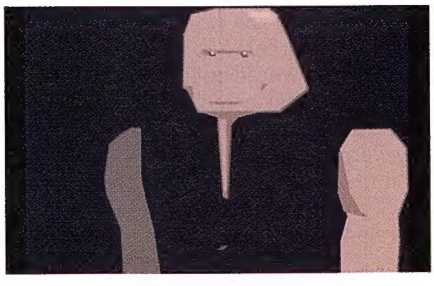
So where would we ultimately be without *Another World*? Well, the more cinematically-influenced games that would follow would have likely taken a little longer to come along, outside of adventure games at least. The quality of the animation achieved through rotoscoping wouldn't necessarily prove very influential, but the final quality of it was something many strived for through other animation techniques. We're not sure that the games of Playdead like *Limbo* and *Inside* would be what they are if Chahi's release hadn't come first. And, tonally, it was more mature and considered than many games had attempted before and hit players in a way that many had never experienced. *Another World* showed that you could bring narrative, action, puzzling and drama to a game experience and still hand over most of the control to the player. That's something that should never be underestimated. ■

## Tricks of the trade

How Eric Chahi made the most of the tech at his disposal to draw us into the story.

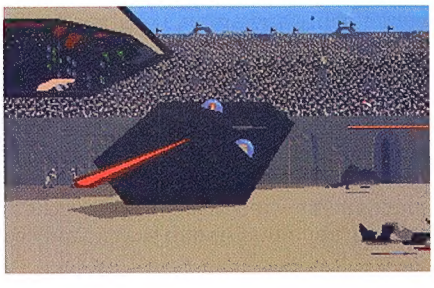
## Suggestive over descriptive

*Another World* didn't have a huge colour palette it could draw from and, thanks to using polygons for its models, there couldn't be a mass of detail either. So the beast at the beginning of the game is nothing but a hulking mass and a pair of red eyes, but with the right shape and movement, that's all that was needed.



## Getting up close

Your companion through much of *Another World*, affectionately known as Buddy by players, gets a brief close-up shot when you meet him so you can see his face. Chahi did that so you had a sense of what he looked like from then on with the less-detailed model.



## The great escape

The big escape sequence at the end of the game is pretty dramatic, but it's made all the more so thanks to the laser fire coming from the foreground and leaving holes in the walls in the background. They can't actually hurt you, but it ups the ante considerably.

Cred: Sputniknews.com

# Bot-based Russian brothel aimed to snag World Cup players

## What's Russian for "Um, what?"

The Dolls Hotel in Moscow is a by-the-hour hotel or 'legal brothel' and features the likes of Alise, Natasha, Lolita, Sasha and Isilel, a bunch of accommodating, big-breasted automated ladies. The founder claims that his dolls can improve your sex life and also make steps towards fighting "one of the oldest problems in Russia – the violent exploitation of women". Sounds great! According to a Russian client who spoke to UK paper *The Sun*, visitors would be impressed with their experience, and that the girls were "very realistic" but to make sure to "use enough lubricant". *Shudder*. While we currently don't know if any members of any World Cup 2018 team actually went to this particular hotel, perhaps this is the reason why so many teams underperformed at this year's tournament – resulting in many upset wins, a high number of own goals and a Grand Final lineup that nobody could have predicted.

## The Scottish clinic that treats crypto-trading-addiction

WHAT'S THE GOOD THING ABOUT CRYPTOCURRENCIES, AGAIN?

These days, it feels as though us weak-minded humans can get addicted to just about anything. In the sleepy Scottish Borders, the Castle Craig Hospital has reportedly set up a clinic to treat those it deems to have developed an addiction to trading in cryptocurrencies. The story was broken by the *Evening Standard* newspaper, with experts telling the outlet that cryptocurrency addiction has been classified as a form of behavioural addiction, much like internet or videogame addiction (recently identified but not universally accepted among the medical community yet as 'a thing'). The treatment program is supposedly similar to the methods used in rehabilitating gambling addicts, as "the high risk, fluctuating cryptocurrency market appeals to the problem gambler" claims the hospital's gambling therapist. Methods include group therapy and socialising with other addicts to help them realise they're not alone.

## School installs facial recognition to determine alertness levels

NO DAYDREAMING ALLOWED!

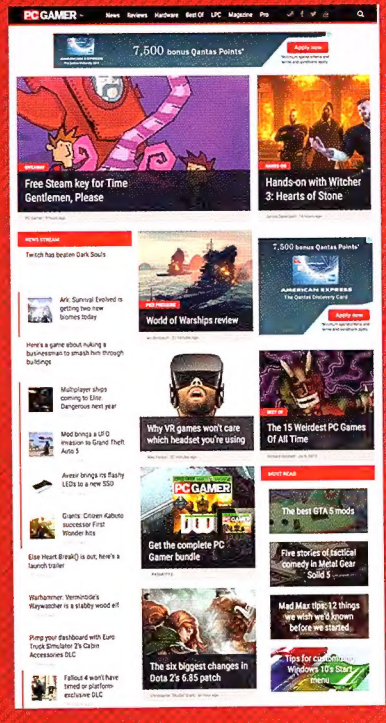
Facial recognition is being employed by many organisations across the world for many different applications (from security to buying fast food), but a high school in eastern China has decided to implement it in an interesting new way called the "smart classroom behaviour management system". Three cameras at the front of the classroom will monitor students' alertness levels by scanning their faces every 30 seconds and determining which expressions they're using. These moods will be averaged for each student and the data made available for the teachers, who will presumably then dish out punishments to those frequently not paying attention. The school began using the system in March, and while it has scared some students into paying more attention, teachers have reportedly been using the tech to change their teaching methods, not to give kids detentions.

## Cryptocurrency stunt goes wrong on Everest

PROMOTION COSTS ONE SHERPA HIS LIFE.

ASKT is a cryptocurrency owned by ASKfm, a social media network all about asking questions and "self-expression". In an attempt to outdo other businesses' "sophisticated marketing techniques", in mid May this year, ASKfm sponsored a four-man team to scale Everest with a nano ledger or wallet containing US$50,000 worth of ASKT as part of a promotional stunt during the cryptocurrency's Initial Coin Offering (ICO) stage. However, this resulted in Sherpa Lam Babu — one three Sherpas who helped the crypto-team — falling behind in the descent. The Seven Summit Treks Company, responsible for hiring the guides, has confirmed that Sherpa Babu is labelled as missing, presumed dead. The CEO of ASKfm has stated that the climbers were planning to attempt the Everest ascent regardless of whether they received sponsorship or not, and told *Finance Magnates* that the company is "saddened and horrified by the outcome" but doesn't believe that ICO marketing has gone too far. ■

# SMARTER COOKIES ENABLED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